2009 ANNUAL REPORT

Research *and* Resources *for the world*

SFBR
Southwest Foundation for Biomedical Research

Board of Trustees

John R. Hurd, chair of the Board of Trustees

COVER: Cultured cells from the interior surface of a baboon artery. After only seven weeks of eating a diet enriched in fat and cholesterol, the nuclei of some cells have abnormally high levels of a dysfunctional protein indicated in green. In addition, the presence of two green nuclei in the same cell indicate that the cell can not divide normally. The cultured cells whose nuclei are blue appear to be normal. The demonstration that eating this kind of diet can cause some arterial wall cells to become abnormal was unexpected, suggesting that even short-term exposure to such a diet can increase risk of arterial damage and atherosclerosis.

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SFBR
SOUTHWEST FOUNDATION FOR BIOMEDICAL RESEARCH

Mission Statement

The Southwest Foundation for Biomedical Research is dedicated to improving the health of our global community through innovative biomedical research.

About SFBR

As one of the world's leading independent biomedical research institutions, the Southwest Foundation for Biomedical Research (SFBR) is dedicated to advancing the health of our global community through innovative biomedical research. Today, SFBR's multidisciplinary team of 72 doctoral-level scientists works on more than 200 major research projects.

Located on a 332-acre campus in San Antonio, Texas, SFBR partners with hundreds of researchers and institutions around the world, targeting advances in the prevention and treatment of heart disease, diabetes, obesity, cancer, osteoporosis, psychiatric disorders, AIDS, hepatitis, malaria, parasitic infections, and a host of other diseases.

SFBR is the site of the Southwest National Primate Research Center and home to the world's largest baboon research colony, including a unique pedigreed baboon colony that is invaluable for genetic studies on complex diseases. The Foundation enjoys a distinguished history in the innovative, humane, and appropriate use of nonhuman primates in biomedical research.

The Foundation also is home to other extraordinary resources that give its scientists and their collaborators an advantage in the search for discoveries to fight disease. With the nation's only privately owned biosafety level four (BSL-4) laboratory, designed for maximum containment, SFBR investigators can safely study deadly pathogens for which there currently are no treatments or vaccines.

Foundation scientists also have built the world's largest computing cluster for human genetic and genomic research. Housed in the AT&T Genomics Computing Center, the parallel-processing network allows SFBR geneticists to search for disease-influencing genes at record speed.

SFBR's population studies include the genetics of complex diseases in a variety of people, including Mexican Americans, American Indians, Alaskan Natives, and Middle Easterners. A project in Nepal is looking at the genetic components of susceptibility to intestinal worm infections using newly developed statistical genetic methods.

Created through the philanthropic vision of Thomas B. Slick Jr. in 1941, SFBR relies on philanthropy to sustain it today. Approximately 68 percent of the Foundation's annual budget is funded by highly competitive, peer-reviewed federal research grants and contracts, while another 8 percent comes from commercial contracts with biotechnology and pharmaceutical firms. Philanthropy constitutes the second-largest portion of the Foundation's budget, as 23 percent of SFBR expenses is met by the generous contributions of foundations, corporations, and individuals, as well as income from SFBR's endowment and royalties.

For more information on SFBR and its efforts to improve human health, contact the Foundation at 210-258-9400, or visit our Web site at **www.sfbr.org**. ■

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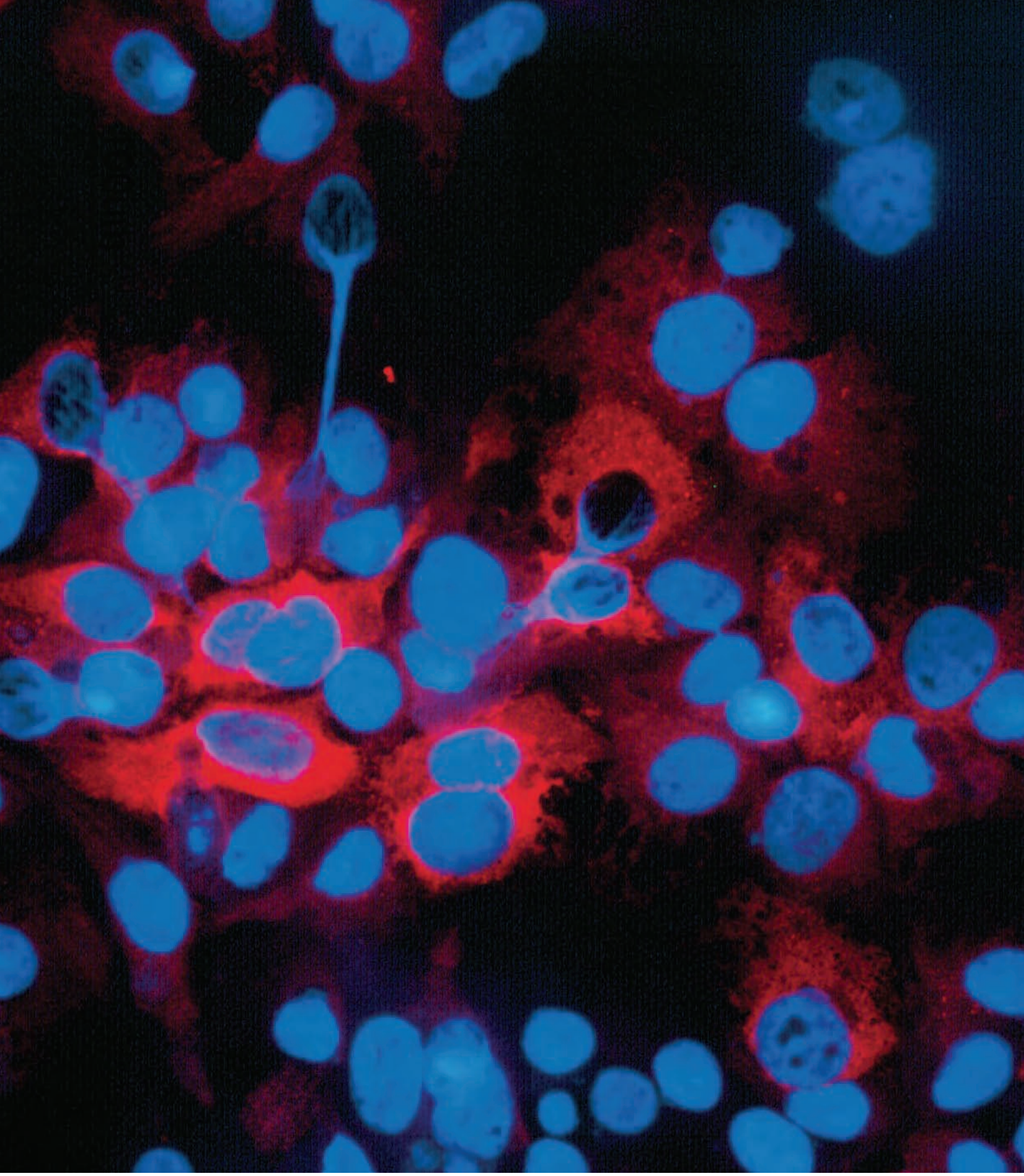


Detection of hepatitis C virus infected liver cells. The red color represents presence of hepatitis C viral proteins and the blue color shows the DNA in the nucleus. The liver cell line was developed from a human liver cancer in the laboratory of Robert E. Lanford, Ph.D., and represents one of the few cell lines capable of replication of hepatitis C virus.

Letter from the President

What a highly productive year 2009 has been at the Southwest Foundation for Biomedical Research. Highlights of the year are featured throughout the pages of this annual report.

The Southwest Foundation is located in San Antonio, Texas, but it truly serves the world. Our scientists are working on projects relevant to you and your next-door neighbor as well as to residents of Thailand, Brazil, the Congo, Nepal, China, Mexico, and a vast host of other countries. These researchers are studying diabetes and Ebola, mental illness and malaria, spinal cord injury and Chagas disease, cancer and tuberculosis, AIDS and hepatitis C, healthy aging and premature births. It is fair to say that each person in our community and in communities across the globe may have a brighter future because of the scientific work being done here.

The research is coupled with an extraordinary and unique collection of scientific resources that are available to our own investigators as well as to scientists internationally. These include our nonhuman primate colonies, our human population studies, the AT&T Genomics Computing Center, and the biocontainment laboratories.

You'll now read about our achievements in these areas earlier in the calendar year. The reason for later publication of the annual report previously was to accommodate the audit process so that financials could bear the imprimatur of an audited statement. However, since the Board of Trustees did not review the audit until June of the following year, this created a long delay in getting important programmatic information to you. Occasionally, news was outdated, and board and faculty members had changed—or at least had changed titles.

Audited statements are vitally important. In this annual report on page 37, we clearly indicate that the financial information has not been audited. We will notify board members and other interested parties when the audited statements are available and how to obtain a copy.

We hope you find this change both satisfactory and appropriate. Please share your thoughts and questions with me about this and other features of the annual report. Is it meeting your need for information? Is it too detailed or too technical? Are there articles you would like to see included? Excluded? Is the print readable and the format "reader friendly"? The SFBR annual report is for you, and we want it to be right.

In the pages of this report, you will find useful descriptions of our research, our resources, and our relevance to the wider community. And I hope that you will understand how seriously we take our responsibility to improve the lives of this and future generations. We must translate the discoveries made at SFBR into new vaccines, new diagnostics, and new therapies. We must extend and expand our collaborations with other institutions to insure that opportunities "to improve the health of our global community" are vigorously pursued. And we must train future scientists from here and abroad so that they can confidently pursue their goals.

The reward of making a difference is an extraordinary gift.

Thank you for being a partner in this pursuit of excellence, this extraordinary journey to eradicate disease and promote public health.

Kenneth P. Trevett
President and CEO

Letter from the Chief Scientific Officer

Foundation scientists had another banner year in making scientific advances that contributed to the SFBR mission of improving the health of our global community.

During 2009, SFBR investigators published 150 manuscripts in the national and international scientific literature. Every one of them is a building block in the global initiative to understand the complexities of animal and human biology. Highlighted later in this report are the advances presented in four of these publications, which illustrate the power of collaborating with other scientists:

- Demonstration in chimpanzees that a novel drug strategy for treating hepatitis C can lead to long lasting suppression of hepatitis C virus particles in blood and liver by a factor of 350-fold (*Science* 327: 198-201, 2010). This drug is now in clinical trials with human subjects and holds great promise for the 170 million people around the globe who are infected with the virus. The research was conducted in collaboration with Denmark's Santaris Pharma and Aalborg University.

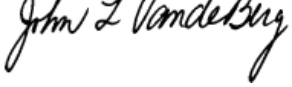
- Identification of factors that have a major role in the development of type 2 diabetes in baboons (*Proceedings of the National Academy of Sciences, USA*, 106:13992-13997, 2009). The new insights gained from this study pave the way for further research with baboons aimed at developing better preventive strategies and treatments for type 2 diabetes. This project included investigators from the University of Texas Health Science Center at San Antonio (UTHSCSA), the Howard Hughes Medical Institute, and institutions in Mexico and Italy.
- Development of a map of the genes of the parasite that causes schistosomiasis (*Genome Biology* 10:R71 [doi: 10.1186/gb-2009-10-6-r71], 2009). Schistosomiasis is a chronic illness that can damage internal organs and, in children, can impair growth and cognitive development. The availability of this gene map will open the doors to new advances in combating this parasite, which infects more than 200 million people worldwide. Collaborators included scientists from UTHSCSA, Texas A&M University, and the Primate Research Institute at Kyoto University in Japan.
- Discovery of the reason why some patients with hemophilia become resistant to treatment (*New England Journal of Medicine* 360:1618-1627, 2009). Hemophilia is a consequence of a mutant clotting protein called factor VIII. Hemorrhage in patients with hemophilia is treated by infusing normal factor VIII into the patients. However, there are several genetic forms of normal factor VIII. This publication reports results that will enable the form of normal factor VIII that is infused to be genetically compatible with the factor VIII mutation that is carried by the patient, saving lives that might otherwise be lost. Scientists based at nine other U.S. institutions participated in the study.

This work was funded by grants and contracts. During 2009, SFBR received the largest grant that it has ever been awarded: a five-year renewal award from the National Institutes of Health totaling $40.3 million to support work conducted by the Southwest National Primate Research Center (SNPRC). This grant makes it possible to conduct cutting-edge research with nonhuman primates, such as the studies on hepatitis C and type 2 diabetes.

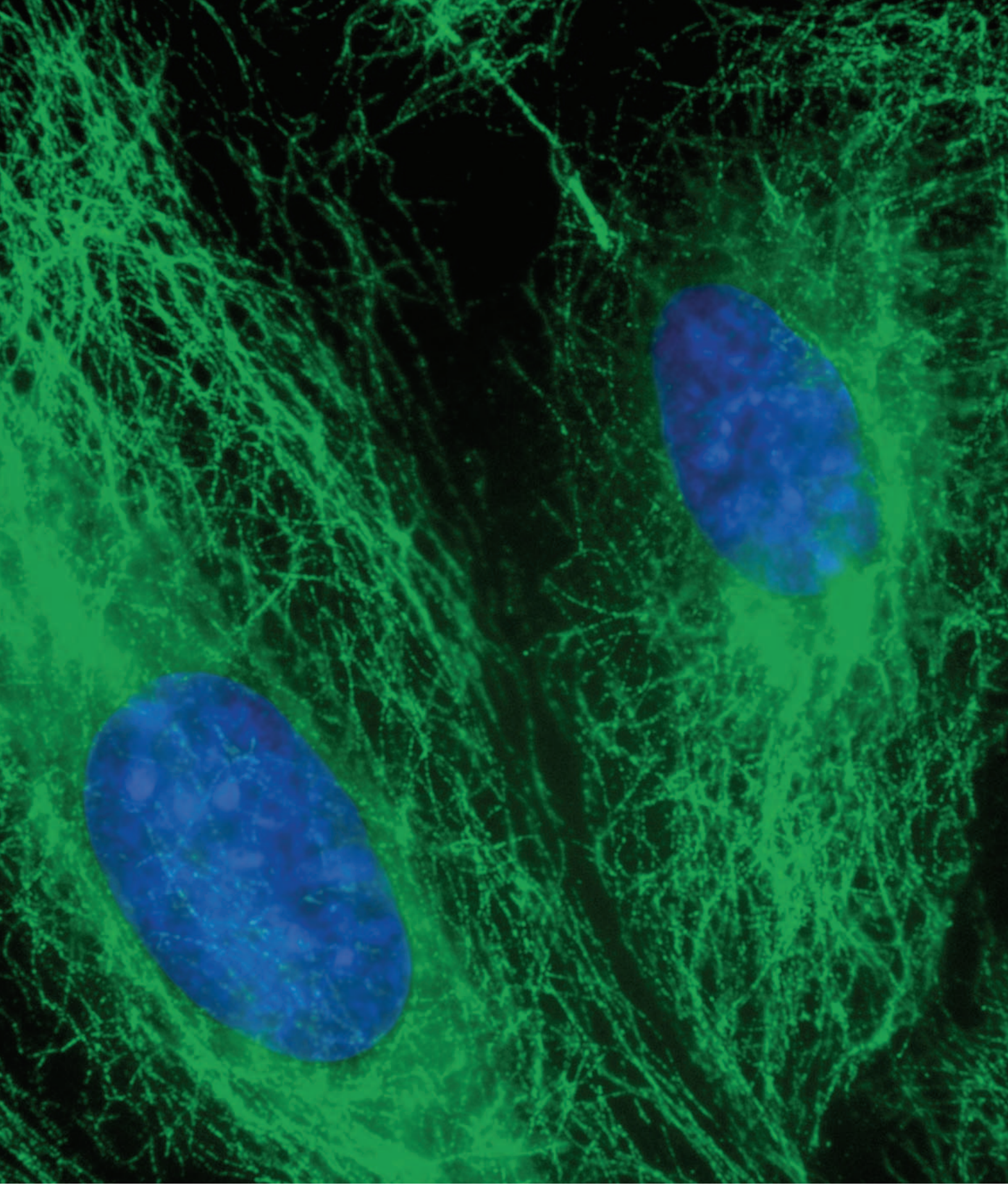
In addition to receiving this award to support the SNPRC, SFBR investigators were awarded $24.4 million in other new grants and contracts to support their research projects. A total of $5.1 million of those funds was awarded under the American Recovery and Reinvestment Act.

Support from our board of trustees and the rest of San Antonio's philanthropic community also is crucial to the success of SFBR. It enables SFBR investigators to conduct small research projects, the results of which are essential to the success of major grant and contract applications, and to initiate new research programs.

Looking ahead to 2010, SFBR is exceedingly well positioned in its portfolio of grants and contracts and in its stellar group of principal investigators whose current research projects are highly productive and hold great promise. It is the vision of these creative scientists that helps fulfill our mission to improve the health of our global community through innovative biomedical research.



John L. VandeBerg, Ph.D.
Chief Scientific Officer



Cellular microtubules (green) and nuclei (blue) in rat aortic smooth muscle cells.

SFBR Scientists Report Advances Against Intestinal Infections, Hepatitis C Virus

Foundation scientists reported important results during 2009 in the fight against infectious diseases that affect millions of people worldwide. For the first time, the scientists constructed a genetic map of *Schistosoma mansoni*, the parasite that causes schistosomiasis, which is a chronic intestinal infection that can damage internal organs and, in children, impair growth and cognitive development. Scientists also reported dramatic results in tests in chimpanzees of a new drug for hepatitis C virus (HCV) infections that target liver cells. The new drug produced a substantial drop in levels of the virus in the blood and livers of the animals, continued to work up to several months after treatment, and did not induce resistance.

Schistosome parasites are flatworms that infect more than 200 million people a year worldwide. Infection results in an estimated 200,000 deaths annually in sub-Saharan Africa alone, while 20 million suffer severe disease, according to the World Health Organization. These parasites have a complex lifecycle. Adult male and female worms measuring about half an inch, live in pairs in the blood vessels, and eggs are expelled in the feces or urine. The larval parasites initially develop in water snails, and human infection occurs when parasite larvae burrow through the skin of people entering the water. An estimated 400,000 cases occur in the mainland U.S. These parasites are an increasing public health threat in developing countries as a consequence of large-scale dam construction projects.

Identifying Mutations

"A genetic map is the essential tool needed for finding the genes that are responsible for drug resistance and pathogenesis in this parasite. In the case of drug resistance, identification of underlying mutations is critical for management of this disease," said Timothy Anderson, Ph.D., of SFBR's Department of Genetics. "First, identification of mutations allows us to better understand the mechanism of action of the drugs used and to redesign drugs to restore treatment efficacy. Second, identification of mutations allows us to efficiently monitor the spread of resistance in parasite populations using simple molecular methods."

The new study was published in the June 30, 2009, issue of the journal *Genome Biology* and was supported by the National Institutes of Health.

Anderson; Charles Criscione, Ph.D., formerly of SFBR and now at Texas A&M University in College Station; and Philip LoVerde, Ph.D., formerly of SFBR and now at the University of Texas Health Science Center in San Antonio (UTHSCSA), used two adult flatworms to breed 88 *S. mansoni* offspring. By comparing the genetic information of the offspring to the parents, they generated a genetic map of chromosomes of the pathogen. Key contributers to the study included Claudia Valentim of SFBR and UTHSCSA and Hirohisa Hirai, Ph.D., of Kyoto University in Japan. Anderson and his colleagues are planning further research using the genetic map to understand why some parasites cause more severe illness than others.

Hepatitis C Study

Another SFBR study found that an experimental treatment targeting hepatitis C was able to inhibit replication of the virus in the blood and livers of chimpanzees and could treat chronic infections in humans. The impact of this important advance was apparent from the extensive coverage in highlights of scientific journals and news stories. The story was picked up by nearly 200 news outlets locally, nationally, and throughout the world. As of early March 2010, a Google search produced more than 8,190 links in languages around the world, including some in Chinese.

The drug, SPC3649, was developed by the biopharmaceutical firm Santaris Pharma A/S in Denmark using its proprietary nucleic acid chemistry called "locked nucleic acid" or LNA. SPC3649 is a DNA-based drug that captures a small RNA molecule in the liver, called microRNA122 (miR-122), that is required for HCV replication.

Timothy Anderson, Ph.D.

"Our collaboration with Santaris Pharma proved that the drug worked exceptionally well in treating HCV infections in chimpanzees," said SFBR's Robert E. Lanford, Ph.D., of the Department of Virology and Immunology. He was the lead author on the study appearing in the December 3, 2009, issue of the electronic version of the journal *Science*.

SPC3649 also showed a high barrier to resistance, a major problem with therapies that directly target the virus. Moreover, this proof-of-concept study suggests that the technology might also prove useful in treating many other diseases such as AIDS, cancer, and inflammatory diseases.

The study was conducted under a sponsored research grant to SFBR. The primate studies were performed at SFBR's Southwest National Primate Research Center, which is supported by the National Institutes of Health.

Potential New Therapy

HCV infections affect 170 million people worldwide and may progress over years to end-stage liver disease, including cirrhosis and liver cancer. In the United States, 4 percent of the adult population is chronically infected with HCV. The only U.S. Food and Drug Administration-approved therapy is interferon and ribavirin, which is highly toxic, requires 48 weeks of treatment, and works in less than half of patients who are able to complete the full course of treatment. HCV infection is the leading reason for liver transplantation in the U.S.

Because it provides a high barrier to resistance, the new therapy could potentially replace interferon in future drug cocktails. "This antiviral could be used alone to treat disease progression, and there are indications that it can convert interferon nonresponders to responders, so that nonresponders to the current therapy could be treated with the combination of this drug with interferon," Lanford said. The new therapy may also be good to use after liver transplantation because it may help suppress the replication of HCV in the new liver. The therapy has no known toxic or adverse reactions, and this is critical in the transplant setting.

In the study, four HCV chronically infected chimpanzees were treated with the new antiviral drug. The two animals that received the higher dose had a reduction in virus levels in the blood and liver of approximately 350-fold. Additional surprising findings were the lack of antiviral resistant mutants and the fact that the therapy continued to work for several months after dosing stopped.

The new study was a critical proof of concept that the LNA technology could work for HCV. It proved that miR-122 is essential for HCV replication in an animal infected with HCV. Previously the role of miR-122 in HCV replication had only been shown in tissue culture. A second advance was the finding that LNA therapy could work against an important human disease in the chimpanzee model, suggesting that the new technology could be applied to other diseases. ■

Remembering Jonathan S. Allan, Early Pioneer in AIDS Research

World renowned virologist and AIDS expert Jonathan S. Allan, D.V.M., 57, passed away on September 27, 2009, following a courageous battle with brain cancer. "Jon was a wonderful colleague and friend to his fellow virologists and immunologists and will be very much missed by his department at SFBR," said Jean L. Patterson, Ph.D., chair of SFBR's Department of Virology and Immunology.

"Jon always had a smile which accompanied his great sense of humor," added SFBR's Chief Scientific Officer John L. VandeBerg, Ph.D. "He was always willing to help when asked, and he made exceptionally thoughtful and articulate contributions to the committees on which he served."

Allan was an early pioneer in AIDS-related research with nonhuman primates. His research focused on the question of why African monkeys that carry SIV, the monkey form of HIV, remain healthy whereas Asian monkeys infected with SIV develop AIDS. A review of this topic, on which Allan was second author, appeared in the August 2009 issue of the prestigious journal, *Nature Medicine* (Towards an AIDS vaccine: Lessons from natural simian immunodeficiency virus infections of African nonhuman primate hosts. *Nature Medicine* 15:861-865, 2009).

Allan also was an author on numerous articles that dealt with transmission of viruses from nonhuman primates to humans. In the 1990s, he became an avid spokesperson against the use of baboons as donors of organs for transplantation into humans. He argued that the risk of zoonotic viral transmission from baboons to humans was great and that viral mutations could lead to new pandemics such as AIDS. His position was controversial and unpopular with many people, but in the end the scientific community reached the consensus that Allan was right. "He performed a great public service by taking this courageous stand, especially since it was the Southwest Foundation that provided the baboons used as organ donors and had the largest breeding colony of baboons in the world," said VandeBerg.

Jonathan S. Allan, D.V.M.

Allan started at the Southwest Foundation as an assistant scientist in the Department of Virology and Immunology on June 15, 1987. He worked his way up through the ranks to become a scientist on December 26, 1992. He was involved in preparing the initial base grant application that led to the establishment of the Southwest National Primate Research Center in 1999, and he served as leader of the SNPRC Retrovirus Diagnostics Laboratory until his death. He also served on the scientific advisory committee of the Foundation for AIDS Research.

In addition to his role as a scientist at SFBR, Allan served as mayor of Helotes, Texas, from 2005 to 2007. He is survived by his mother and two brothers. ■

SFBR Scientists are Enthusiastic About the Progress and Promise of Genetics Research

The Southwest Foundation for Biomedical Research is home to the world's largest computer cluster for human genetic and genomic research. SFBR's "computer ranch" currently contains 3,000 processors working in parallel to crunch out the data necessary to help scientists find disease-influencing genes. A federal grant will soon allow the purchase of an additional 5,000 processors. One of the goals of this research is to transform genetic information into personalized medicine that can identify an individual's risk for disease and response to treatment. For this roundtable discussion, annual report editor Joseph Carey interviewed four SFBR scientists: Laura Almasy, Ph.D., John Blangero, Ph.D., Laura Cox, Ph.D., and Eric Moses, Ph.D.

Laura Cox, Ph.D., and John Blangero, Ph.D.

Q. What makes the idea of personalized medicine possible?

Blangero: The major development that has led to us being able to entertain this question stems from the Human Genome Project, the government program completed in 2003 to identify all of the approximately 20,000-25,000 genes in humans. We can now assess many different genetic variations in individuals with relatively little time and effort. In the near future, maybe five years, we will be able to sequence whole human genomes for a reasonable cost and use this information to help patients.

Almasy: Personalized medicine has actually been practiced for a long time. It has been the case for decades that your doctor asks about your family history, and if your parents had heart disease or breast cancer. The answers inform your doctor's decisions and your decisions about your health.

Moses: We've made major advances in new technology within a relatively short period of time. A carefully designed study lays the foundation for the work and the use of the technology. SFBR's San Antonio Family Heart Study is a good example. You can't just have sequences, you've got to have people, collect the appropriate samples and understand family relationships.

Cox: We're applying the same technology in the pedigreed baboon population to explicitly test different environmental factors which you cannot control in human studies. Baboons are genetically very similar to humans. We can assess what happens if you put the animals with a certain genetic background on a high fat diet. We actually go back and forth where the studies in the baboons inform the studies in humans and the reverse.

Q: Can you give us a good example of the baboon informing the human situation?

Almasy: One thing that comes to mind is the concern about all the sweetened beverages that are becoming so popular in the American diet. This has led scientists here at the Foundation to look not only at high fat challenges in baboons, but the effect of adding sweetened beverages to those dietary interventions to assess what the combined challenge does to the body composition.

Cox: And in the longer term, we'll learn a lot from studies of gene and environment interaction. If we find a gene that regulates HDL cholesterol in the baboon, we can then look at the human population to see if we find the same genetic effect in humans. Do we see the same kind of variance?

Eric Moses, Ph. D.

Then we can go back to the baboon model to test it. So it is a constant dialogue back and forth between studies.

Blangero: And in the other direction, if we find a novel gene that we think involves cholesterol metabolism in humans, we can go to the baboons where we can do a much more elaborate physiological evaluation and examine the environment to see if it's also playing a role there.

Q: Where do you see your study areas headed over the next two years and into the future?

Moses: My main interest is pre-eclampsia, which is a common pregnancy disorder that has some overlap with the risk of cardiovascular disease. There are no predictive tests that the clinician can use when treating women during pregnancy. Typically what happens is that this disorder affects about 2 percent to 5 percent of all pregnant women and it appears suddenly, usually after mid-gestation when nothing can be done, except deliver the baby. The obstetricians that I collaborate with around the world all want some early diagnostic or predictive test that they can use at an optimal level with all the women who are under their care. What they say to me is that if they had such a test and had patients that were of high risk, they would manage them in a totally different way. Getting to a cure is not necessarily in a future I can see, but improved management of the disease is possible if risk of pre-eclampsia can be predicted accurately.

Q: When you're talking about a test, are you talking about a blood test?

Moses: It would probably be a blood test that is administered at the third prenatal visit. It could even be before pregnancy. So we're attempting to identify as many of the genetic risk factors as we can. Hopefully, some of those will result in a predictive test.

You can't just have sequences, you've got to have people, collect the appropriate samples and understand family relationships.

– Eric Moses, Ph.D.

Q: You've identified a few genes that may be involved in predicting disease, correct?

Moses: We've got some interesting candidates. And similarly to cardiovascular disease, it is likely that there are many more genes to discover.

Almasy: Genetics can also be used to predict optimal drug treatments. One area with which I'm involved is psychiatric genetics. It is often difficult to find pharmacological treatments that work with minimal side effects in all patients. There is great interest in identifying genetic factors that would get people to the right treatment quickly. Some pharmaco-genomics studies have identified variants in common drug-metabolizing enzymes that appear to be related specifically to side effects. People with a particular variant may metabolize drugs more quickly. You need to start them on a lower dose, because if you start them on a standard dose, it is toxic and they get sick.

Q: Can many variations result in disease, not just a single gene?

Blangero: Exactly, but take diabetes, where we have put an enormous effort into finding genes. Right now, just for type 2 diabetes, there are about 34 to 35 gene signals that people agree on. They end up accounting for less than five percent of the total variation of diabetes risk, whereas we know that genetics accounts for 60 percent of diabetes risk. Where is the rest of the variation? It is going to be these rarer variants that probably have a much more potentially functional effect on biology.

Almasy: Imagine metabolism as a kind of Rube Goldberg machine, where this thing activates that thing which then activates that thing. When we are looking at these critical diagnoses, all we are seeing is the final thing, when the ball drops into the bucket. And there are a thousand ways you can break things down along that chain that result in the ball not dropping in the bucket. I think that occurs with common diseases. There are thousands of different ways you can break down a small part of the system resulting in the same end—the ball did not drop into the bucket.

Blangero: The idea that we are going to improve our risk assessment is probably on a less strong basis than the idea

that we are going to find some genes that are going to be very useful for us in targeting new medicine. The use of genetic information to better tailor drug therapy for individuals is where I think there will be rapid progress. If you look at the cancer field now, you can start to see how a person's metabolism of a drug, and the makeup of a tumor itself, can help inform clinical decisions. There is huge interest in being able to improve the utility of drugs that are not in use because of their negative side effects in some individuals. The ability to identify people who are genetically unlikely to tolerate these drugs will allow physicians to target use of the drug to only those who will be able to tolerate it. Such pharmacogenetic approaches could save a lot of time and money in getting effective treatments to people.

Q: Dr. Cox, can you describe some of your work in cardiovascular disease along these lines?

Cox: Our research on heart disease in baboons involves looking at the effects of environmental challenges so that we can see gene-environment effects in action. We've got a couple of studies going in my lab where we are studying genetic variations related to HDL (good) cholesterol and LDL (bad) cholesterol. And we've gone from whole population studies to focusing on segments of the population. We're looking at very high and very low responders to dietary fat and dietary cholesterol. The really interesting thing is that when we look at these high and low responders, not only do you see variations in this one gene, but in an entire genetic network that is activated in the high HDL cholesterol responders. And that whole network is not as activated in the low responders. If you know the whole network, you know where the network breaks down, and that provides you with specific therapeutic targets.

Laura Almasy, Ph.D.

Q: How big a role does environment play in developing a person's likelihood of getting disease or preventing it?

Cox: One of the current fashionable terms in science is the epigenome, which is basically how the environment—such as stress, diet and behavior—has modified the genome and yet not modified the essential sequence of DNA. The epigenome is a history of what has happened to that genome through environmental actions over generations. And that history also plays a role in how that individual responds to an environmental challenge. Say you have a gene variant that puts you at a high risk for heart disease, but you have two gene copies—a good variant and a bad variant—and the bad variant isn't expressed and the good one is expressed. You would be less susceptible to heart disease than somebody in whom the bad variant is expressed. All of the technologies used for genome sequencing can be used to assess some of the central aspects of the epigenome.

Q: Is there a danger in employers or insurance companies using genetic information to influence decisions on whether to hire or insure somebody?

Blangero: There are laws on the books, but it is still something that people will have to become more familiar with and realize that with these great advances come risks that we have not really faced to such a degree before. The other thing is that, unfortunately, physicians are not ready for it. They are not trained. A physician is lucky to have had two four-hour lectures on genetics. It is going to require some significant physician training to prepare them for the potential of personalized medicine.

Q Can personalized medicine solve the problem of spiraling health care costs?

Almasy: It would save a lot of money if we can keep people with schizophrenia functioning and employed and off the street and out of hospitals and jails. Or with type 2 diabetes, if it keeps a certain proportion of individuals from getting to the end stage of diabetic kidney disease and having to go into extraordinarily expensive treatment, then there is going to be a net savings.

Q: When will genetics transform patient care?

Almasy: Personalized medicine is already making a difference in the cases that we have talked about. It is going to be a slow progression of these kinds of examples of gene products that respond to particular drugs based on screening tests before people start getting them routinely.

Blangero: We're just at the point where we're thinking about how to use an individual's complete genomic information. The technology will become cheaper and simpler, and will make much larger studies feasible. And then those much larger studies will be the ones that really bear lots of fruit and will transform the practice of medicine. ■

Blood Glucose Levels and Diabetes: Probing Our Community's Greatest Health Threat

Scientists looking at a damaging protein buildup in the pancreas of diabetic baboons have found striking similarities with the way the disease progresses in humans. This work advances research into type 2 diabetes by further validating the baboon as an animal model for diabetes investigations, according to scientists from SFBR and the University of Texas Health Science Center at San Antonio (UTHSCSA). The study is an example of valuable collaboration between the two institutions.

Findings of the study, led by Franco Folli, Ph.D., M.D., professor of medicine and director of metabolic and molecular research at UTHSCSA, were published last summer in the *Proceedings of the National Academy of Sciences, USA*.

The study builds on research from a previous collaborative study led by Folli between UTHSCSA and SFBR, showing that glucose metabolism is impaired due to insulin resistance in obese baboons. The same is true of humans. In humans, type 2 diabetes, previously a disease of adulthood, has increasingly developed in children and very young adults, due in part to an epidemic of obesity.

SFBR geneticist Anthony Comuzzie, Ph.D., who worked with Folli and his group on the latest study and previous collaborations, said the new findings greatly affect his own efforts in recent years to establish the baboon as an animal model for diabetes research.

"It is a critical advance in promoting this model as a relevant example for type 2 diabetes," Comuzzie said. "The study validates the baboon model. Baboons aren't just a model for the disease. They are the disease. They suffer through the same kinds of conditions that we do in developing diabetes."

Diabetes affects an estimated 24 million people in the United States. It is a disorder in which excessive glucose builds up in the blood, causing damage to blood vessels and other cells.

The study examined pancreatic tissue from baboons that had died of natural causes, including diabetes, also using data from SFBR's Veterinary and Pathology units. The results demonstrated that deposits of the protein hormone islet amyloid polypeptide (IAPP) in the islets of Langerhans, the area of the pancreas that makes glucose-controlling hormones, can lead to two negative factors associated with the development of diabetes in baboons.

Anthony Comuzzie, Ph.D.

Buildup of IAPP alters the microenvironment of the islets of Langerhans and kills the "beta" cells, the ones that produce

Baboons at the Southwest National Primate Center were vital to the diabetes study.

insulin, which the body needs to lower blood glucose levels. At the same time, the microenvironment promotes the replication of the "alpha" cells that produce a second hormone, glucagon, which raises blood glucose levels. The deposits worsen as glucose increases.

That same phenomenon occurs in humans and contributes to the progression of diabetes. Beta cells die in the amyloid-altered environment, but alpha cells proliferate, Folli said. "It's really an imbalance. Both activities are not normal and produce an undesirable effect, ultimately type 2 diabetes."

Scientists have long known that glucagon is increased in type 2 diabetes but had no explanation for this phenomenon. "Finally we have a very plausible explanation of the increased glucagon levels," Folli said. "We have shown that the baboons have insulin resistance like humans and also that the baboons have lesions in the pancreas that are identical to the lesions found in humans."

Folli noted that an inspiration for the study were data from Southwest National Primate Research Center veterinarian pathologists Gene Hubbard, D.V.M., and Edward Dick D.V.M., which documented a protein buildup in baboon pancreatic tissue. Hubbard, who retired from SFBR about a year ago, now is a research professor at the UTHSCSA Barshop Institute for Longevity and Aging Studies.

The SFBR scientists inspired Folli to look through the records of more than 4,000 baboons that had died of natural causes and studied their pancreatic tissue and triglyceride, glucose, and cholesterol levels. His group demonstrated with cellular, molecular, and mathematical approaches the key pathologic role of IAPP deposition in type 2 diabetes in the baboon.

In baboons and humans, the protein deposits cause a "double whammy" effect that impairs the ability to produce insulin, as well as the ability to metabolize glucose, Comuzzie noted. "Not that it is a single cause of diabetes, but it certainly contributes to that progression," he said, adding that, while the finding is not a treatment, "this latest study identifies a mechanism for other experimental work where you could manipulate it or treat it." ■

Mismatched Replacement Products May Triple Likelihood Black Patients with Hemophilia Develop Resistance to Therapy

SFBR researchers performed a crucial role in a study that could help answer a question that has perplexed doctors for years: Why are black patients with hemophilia twice as likely to develop resistance to therapy designed to restore the body's blood-clotting function?

In hemophilia, a rare disorder that occurs mostly in males, a patient's blood does not clot normally. This may result in longer than normal bleeding after an injury. Hemophilia may also cause internal bleeding that damages internal organs or tissues and may be life-threatening. In the United States, about 18,000 people have hemophilia, and about 400 babies are born each year with the disorder.

The study of 78 patients, results of which were published in April 2009 in the *New England Journal of Medicine* and funded by the National Heart, Lung and Blood Institute of the National Institutes of Health (NIH), may have an impact on other areas of medicine, ranging from cardiovascular disease to transplantation. Because of the significance of the results, NIH has funded a second study that began in November, which will involve approximately 1,200 patients.

Tom Howard, M.D., Ph.D., principal investigator of the study, conducted much of the research while on staff in the Department of Genetics at SFBR. He is now director of the Coagulation and Molecular Pathology Laboratories at the Veterans Affairs Greater Los Angeles Healthcare System. Others from SFBR included genetics researcher Laura Almasy, Ph.D., whom Howard enlisted because of her statistical genetics analysis expertise, and Shelley Cole, Ph.D., director of the Genetics Core Lab, who conducted DNA sequencing. Kevin Viel, Ph.D., who worked as a post-doctoral researcher at SFBR, provided additional statistical analysis. Viel now works in Atlanta as senior research statistician with St. Joseph's Translational Research Institute. Almasy, Cole, and Viel also will participate in the new study.

The new finding focuses on a gene known as the "factor VIII" gene, which codes for production of a protein, factor VIII, which is essential for blood clotting. The discovery that different individuals have different versions of the factor VIII protein is "a real dogma-breaker because everyone used to think it was the same molecule for everyone," said Howard.

Shelley Cole, Ph.D.

The study, titled *Inhibitors of Factor VIII in Black Patients with Hemophilia*, concludes that genetically mismatched products for replacing factor VIII may be the reason that black patients have a higher rate than others of developing antibodies that inhibit the therapy from working.

Regular infusion of factor VIII protein derived from plasma or synthesized in a laboratory is the standard method of treating hemophilia patients to arrest their tendency to hemorrhage. However, the study found six inherited variations, or haplotypes, of the factor VIII gene, each of which encodes a distinct factor VIII protein. Three of them, H3, H4, and H5,

are found almost exclusively in black people. Nearly one in four blacks has one of those factor VIII gene variations.

The study notes that the factor VIII replacement products available for clinical use are not modeled on the haplotypes found in a substantial proportion of black patients. That may be causing the immune systems of many black patients to more readily recognize the replacement products as foreign and to create antibodies that inhibit the replacement products from working.

The two recombinant replacement products approved for use in patients with hemophilia do not correspond to H3, H4, or H5. They correspond to the amino acid sequences of either H1 or H2, the only factor VIII protein variants found in whites. Factor VIII derived from plasma also is likely to mismatch black patients because most blood donors are white, and have factor VIII types H1 or H2.

"Of the studies with which I've been involved, this one has the greatest possibility of having immediate clinical impact," said Almasy, who joined SFBR in 1996. "The results have immediate implications for treatment of patients. It would not be difficult to implement the findings in individual treatment regimens because they are making these synthetic products now, and they would only have to make small changes to make synthetic products that are matched to types H3, H4, and H5."

Because the development of inhibitors can result from a complex combination of factors, including how many times a patient has been exposed to replacement products and the type of mutation in the factor VIII gene, Almasy's statistical analysis came into play.

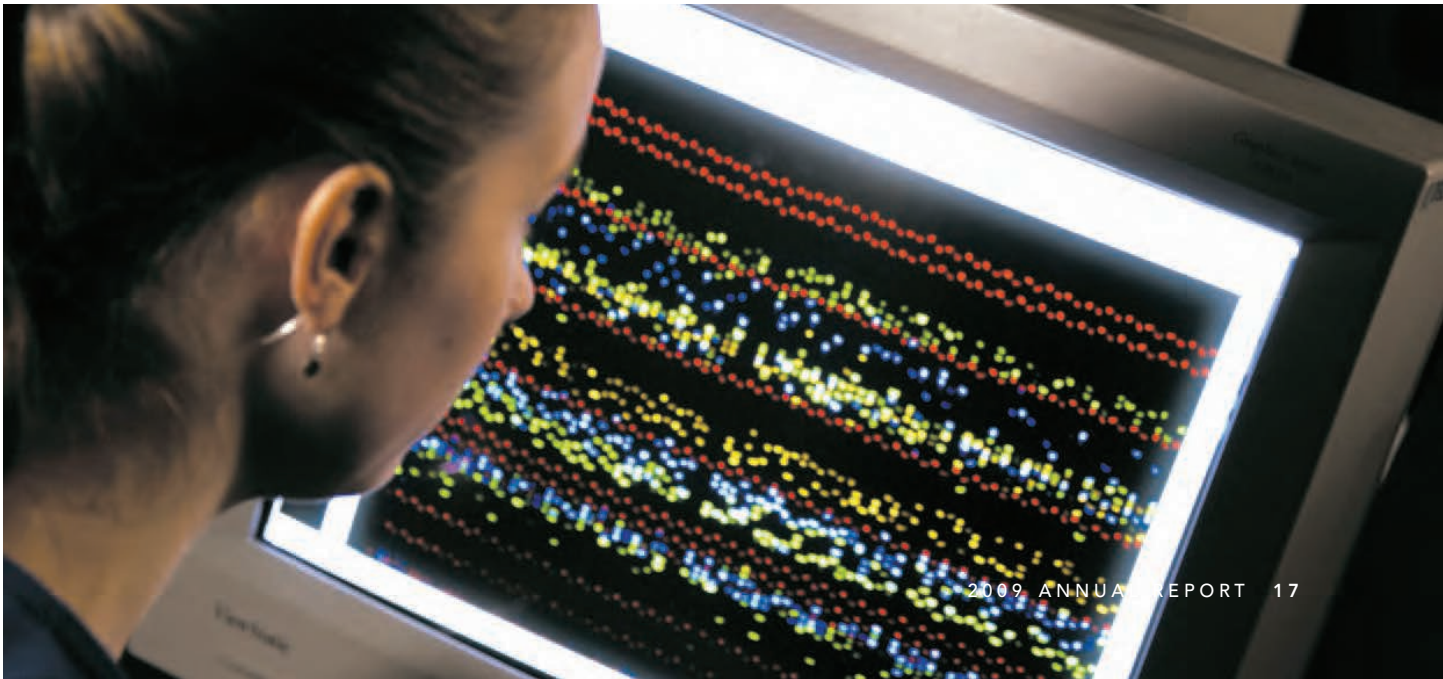
"Both groups get some inhibitors, and we rely on statistical testing to decide whether the pattern of differences we see between the two groups could be due to chance or whether there is a big enough difference between the two groups to indicate that it's very unlikely it just happened by chance," Almasy said.

The previously unknown level of genetic diversity discovered in this study and its apparent impact on the body's ability to accept donor material has implications for many other areas of medicine. "If this finding is true, then potentially it will reverberate through any field of medicine in which human-derived materials are used," Viel said. "This study may suggest that apparently minor differences in a protein—importantly, differences that are not associated with pathology, such as hemophilia, but found to be naturally occurring in normal subjects—can elicit immune responses, some of which will neutralize the transfused protein, rendering vital treatment less effective."

The researchers cited the potential for improving treatment of other single-gene disorders such as von Willebrand disease, a hereditary bleeding disorder affecting up to 1 percent of the population, male and female. Howard noted that the new findings also could apply to thrombophilia, the tendency for excessive clotting, and to an increased understanding of the blood clots that typically are involved with heart attack and stroke, the number one and number three causes of death in the United States.

Howard said that even the preliminary study's effect on the research world has been strong. "As soon as we published the study, people started sending e-mails telling us of the potential impact on studies they are doing," said Howard.

Cole, who is working with Howard on the new, larger study, also found it especially rewarding "to contribute to something that might improve someone's life over the next decade." ■



Pioneering Chemist Pemmaraju Rao Retires, Became Leader on Steroids and Women's Health

When he moved to San Antonio from India in 1958 to join a group that recruited him to do human hormone research, Pemmaraju N. Rao planned to spend maybe a few years at the Foundation and then return to his native country.

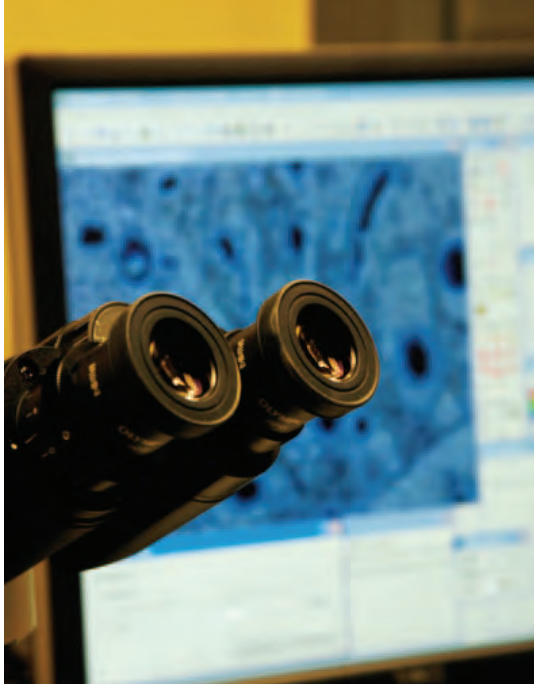
Rao's plan didn't work out that way. Rapid developments in the cutting-edge field of hormone research, including U.S. approval of the first birth control pill two years after he arrived, kept Rao immersed in a field in which he would become a leading authority.

He stayed until 2009—51 years and 18 patents later—when he finally retired from SFBR, departing as one of the world's foremost experts on steroid chemistry, women's fertility, and cancer. *Steroids*, a monthly scientific journal, named him its top reviewer for 2009.

If Rao were like most people, he would have stopped working to spend more time pursuing his recreational passions, gardening and photography. Because he holds an even greater passion for science, his research career continues today with the Foundation's first spinoff company, Evestra™, where he is senior vice president of research. The new company was built on his life's work at SFBR in discovery and synthesis of novel steroid compounds essential to many female health care applications, including contraception, gynecological diseases, hormone-replacement therapy, and hormone-dependent breast cancer.

All of this is far from his upbringing in the state of Andhra Pradesh in southeastern India, where he was born in 1928, the son of a civil engineer. Rao has always had a fascination with photography, a hobby he still pursues. His office wall today has a large black-and-white print of a Hindu temple that he

Pemmaraju N. Rao in his laboratory at SFBR.



photographed in India with a Kodak Brownie camera more than half a century ago.

Rao's fascination with science, especially chemistry, overshadowed all other interests, making him determined to pursue science, despite the view among many in India that it wasn't the best career choice. He earned a Ph.D. in organic chemistry at Calcutta University. "In those days, people wondered what kind of future a scientist had, particularly in India, because it was a developing country with no major research of any kind, and the British had not promoted research in India," said Rao.

His research and related patents have had a marked impact on physicians' abilities to diagnose and effectively treat patients with a wide range of disorders. He was chair of SFBR's Organic Chemistry Department from 1977 until the end of 2008 when that department became the core of Evestra™, operating from the SFBR campus. Rao's honors include the title senior scientist and the Maltese Cross, a symbol of intellectual acuity awarded by the SFBR Board of Trustees. SFBR named that portion of the building that housed Rao's former department the Dr. Pemmaraju N. Rao Wing.

"P.N. is a true gentleman," said John L. VandeBerg, Ph.D., SFBR's chief scientific officer and director of the Southwest National Primate Research Center. "With his gentle but firm demeanor, he provided dignified leadership to SFBR for five decades; and he always displayed the highest respect for his colleagues and peers. He is one of the pioneers of the institution and his legacy to it will always be remembered and appreciated."

Advanced laboratories and other assets at SFBR and Evestra™ today are worlds away from Rao's humble beginning at the nascent institution then known as the Southwest Foundation for Research and Education. Upon arriving with his wife, Suvarna Rani Pemmaraju, and their eight-month-old daughter Uma, he thought that maybe he should have done more investigation into what his working conditions would be like in San Antonio. "I said I would come and spend maybe two or three years, maximum," said Rao. "Then I saw the research laboratories on Callaghan Road, which were a shock to me." They were a bunch of barns converted to research labs where lack of air conditioning made the work space so hot that research had to be done at night. Although he found the old, wooden buildings disappointing, Rao and the handful of other scientists on staff remained enthusiastic about the promise of complete scientific freedom and the inspiration of SFBR founder Tom Slick.

With his gentle but firm demeanor, [Rao] provided dignified leadership to SFBR for five decades.

– John L. VandeBerg, Ph.D.

Indeed, Rao's retirement marks the passing of an era for SFBR. "He is about the last of the true pioneering researchers who came to the Foundation back in the 1950s when it was Tom Slick's vision, at a time when there wasn't any other research taking place in the city," said former Board Chair John C. Kerr. "It really took a lot of courage and foresight to come here and develop a research program with very few community resources available."

After hearing glowing reports about research opportunities in America, Rao applied for and won a Fulbright Scholarship and worked at the University of Rochester Medical School in New York. He worked in Rochester in 1954-55, studying hormones, such as the newly discovered corticosteroids.

Rao returned home to work in Poona, India, at the new National Chemical Laboratories at a time when that nation made a big push to develop its scientific base. "I started working in the field of steroid hormones, because that was still a brand-new field, and nobody had been working in it," Rao said. "India has a lot of raw materials to make these steroid hormones. I thought it was a wonderful opportunity to develop the field. For the first time, we started making progesterone, a female hormone, from Indian raw materials." Rao also developed expertise in cholesterol, which he describes as "the mother" of all hormones.

He loved India, but his group from Rochester was moving its research programs to the new research center in Texas and recruited Rao to join scientists such as Nicholas T. Werthessen, Ph.D., a pioneer in the study of atherosclerosis, and Leonard Axelrod, Ph.D., an expert in steroid biochemistry. Rao became involved in a new project looking at the process of steroid metabolism.

"It was a group effort: biochemistry, endocrinology, and physiology and medicine. That's how we started to make some breakthroughs in this area," Rao recalled. It was a boom time for his field of research. Rao was very interested, having come from a country trying to get its population explosion under control.

Scientists seeking to improve contraceptives and to treat numerous hormone-related conditions needed a means of measuring levels of specific hormones in patients. Rao and his collaborators developed new methods to provide quick and accurate measurement of those hormones, for which he holds several patents. Those methods are commonly used today in laboratories worldwide for diagnosis of numerous health disorders, greatly improving the quality and efficiency of medical care for millions of people.

"We pioneered some of the methodology for measuring these steroid hormones in body fluids by a technique called radioimmunoassay," Rao said. "While we were not the only ones, we pioneered and developed many methodologies here."

Initially, it took a day or two to obtain analysis results. Further research by Rao and collaborators shortened that time to a few hours, providing doctors quick access to diagnosis and treatment. "There's a certain precise balance," Rao said. "To know exactly what the level is and what the abnormalities are, one has to have a reliable method of measuring these hormones. That is the technology we developed."

His research has led to breakthroughs in individual patients' ability to tolerate hormone therapy, treatment of male and female fertility, and detection of potential fetal development problems. Other important medical advances from his research include treatment of certain hormone-related cancers and other diseases with "anti-hormone" compounds that he and collaborators developed. These advances have been incorporated into treatment without surgery for such conditions such as fibroid tumors, endometriosis, and breast cancer.

Frank Ledford, M.D., SFBR's president from 1992 to 2005, recalled Rao as a highly respected scientist from the "old school," who dressed the part in a tie and lab coat and helped the Foundation develop into a world-renowned institution. "The people who worked for him voted for him by staying with him at all costs," Ledford said.

Rao and his wife have witnessed many changes in San Antonio over five decades. No other Indian families lived in the city in 1958, although today the city has several thousand households of Indian descent. "People used to say, 'From which reservation?,'" Rao recalled.

He and his wife, who became a yoga instructor after moving here, raised three children, sons Rama Krishna and Sankar, who are practicing medicine in Dallas and Fort Worth, and daughter Uma, now a Fox News anchor in New York.

Rao has traveled most of the world and says he has seen the places he wanted to see. His main recreational outlet these days is his organic garden, which provides certain Asian peppers and vegetables not readily available in Texas for his vegetarian diet. The garden also provides another laboratory for Rao, who conducts experiments with the plants, just for fun.

The scientist in him never quits. ■

Pemmaraju N. Rao and his wife, Suvarna Rani Pemmaraju, at his retirement celebration.

Celebrating Achievements in Primate Research: New Book, SNPRC 10th Anniversary

Among the major highlights of calendar year 2009 were the publication of *The Baboon in Biomedical Research* and the celebration of the 10th anniversary of the Southwest National Primate Research Center (SNPRC). Both events underscored the many important contributions made by the SNPRC to research and its role as a resource for investigators throughout the United States and the world.

The Baboon in Biomedical Research, edited by John L. VandeBerg, Ph.D., Sarah Williams-Blangero, Ph.D., and Suzette D. Tardif, Ph.D., builds on and updates two earlier volumes that outlined the many uses and the importance of the baboon in biomedical research. The book serves as an introduction to 50 years of research on this nonhuman primate model and as a valuable guide to researchers and laboratory animal veterinarians.

Joseph Kemnitz, Ph.D., director of the Wisconsin National Primate Center

The 391-page book begins with chapters on the baboon gene map, the first genetic linkage map developed for any nonhuman primate species. Other chapters focus on the results of decades of research on basic biological characteristics of baboons: microbiology, reproduction, growth and development, behavior, and many models of disease and physiological or developmental conditions.

A Valuable Resource

The baboon is a very useful model for several reasons. "It closely resembles humans in a variety of physiological and disease processes, such as cholesterol metabolism, early stages of atherosclerosis, and alcoholic liver disease," said VandeBerg, SNPRC's director. "Many of its chromosomes closely resemble those of humans. The baboon genome is currently being sequenced, and, as a result, the utility of this species for biomedical research will be dramatically increased."

At SNPRC, the baboon has been found to be a very useful model for a variety of disorders. Baboon studies verified efficacy of surfactant treatment to prevent or treat pulmonary distress in premature infants. These animals were also instrumental in developing the high frequency ventilator to rescue premature babies from death or lifelong disabilities. The ventilator is now used to treat respiratory distress syndrome, the disorder that killed President John F. Kennedy's son Patrick, who was born six weeks prematurely in 1963. If he had been born today, thanks in large part to surfactant and high frequency ventilators, he would have had a 95 percent chance of survival.

The baboon has also proved useful for developing a vaccine for schistosomiasis infection, a debilitating tropical disease that infects an estimated 200 million people worldwide.

In addition, the baboon serves as a model for identifying the genetic determinants of obesity and is being developed as a

model for diabetes. Scientists are using the baboon to study atherosclerosis, alcoholic liver disease, drug abuse, epilepsy, osteoporosis, endometriosis, dental development, various aspects of reproduction, infant nutrition, stress, anorexias, high blood pressure, aging, and cross-species organ transplantation.

SNPRC 10th Anniversary

Much of the research on baboons and other primates was discussed during the SNPRC 10th anniversary celebration held on October 1, 2009, with a program highlighting the center's history and accomplishments in the areas of infectious diseases and biodefense, development and aging, and chronic diseases and genomics. In addition, the SNPRC's base grant was renewed by the National Institutes of Health (NIH) for another five years with funding of $40 million.

Established in 1999, SNPRC became the first new National Primate Research Center (NPRC) in more than 35 years. The SNPRC brought a number of unique strengths to the NPRC program, stemming from a long, productive history of nonhuman primate research at its host institution, the Southwest Foundation for Biomedical Research (SFBR). It currently maintains more than 3,500 primates for breeding and research purposes.

"These unique strengths include the world's largest research baboon population, the world's largest and best-characterized pedigreed primate population, the world's largest group of geneticists committed to research with and management of captive nonhuman primates, and high level biocontainment and infectious disease research," said VandeBerg.

Sessions during the October 1 event held at SFBR included comments from representatives of the NIH, officials of other primate centers, and current and former SNPRC leaders. NIH officials reviewed the history of the development of the SNPRC and future directions for primate research. They noted

how much the "baby" of the primate centers program has accomplished in its first ten years, bringing expertise in genetics, bioinformatics, genetic management, and virology and biocontainment to the program.

Leaders at U.S. primate centers located at Harvard University, the University of Wisconsin, Wake Forest University, and Tulane University described how collaborations with the SNPRC are critical for advancing research at their own institutions. William Stone, Ph.D., a mentor and close friend of VandeBerg, reviewed major advances in human medicine based on research using chimpanzees, baboons, and rhesus monkeys.

SNPRC provides broad collaborative opportunities in primate research to investigators across the country and serves the entire nation with specialized technologies, capabilities, and primate resources, many of which are unique to the center.

While the SNPRC celebrated its 10th anniversary in 2009, SFBR scientists obtained their first research baboon in 1956, shortly after the discovery of fatty plaque in the aorta of a female baboon that died at the Audubon Park Zoo in New Orleans—providing scientists with their first good animal model for human heart disease. The population quickly grew and became an important scientific asset to the nation.

The federal government in 1961 established seven national primate research centers. SFBR applied for the designation but was not selected. Why it was not chosen was never clear. "I asked that question periodically of just about anybody who would listen, and I never got a satisfactory answer," said VandeBerg, who pushed for years to have the Foundation's primate resources added to the group.

In 1961, federal officials thought the baboon wasn't completely established as a model for heart disease, said Jerry Robinson, Ph.D., who oversaw the primate program for NIH's National Center for Research Resources (NCRR) from 1995 to 2004.

But in 1999, in part because the race for an AIDS vaccine required more primate research, the NIH solicited applications for another center. SFBR was ready and was awarded the designation.

Moving into the future, Jack Harding, Ph.D., NCRR's current director of primate resources, noted that the agency continues to put emphasis on the importance of translational research, one of SNPRC's strengths. He also said that consortium-building among the eight NPRCs is important for them to be as effective as possible.

Among SNPRC's many accomplishments are advancing the understanding of cholesterol metabolism; identifying genes that influence heart disease, obesity, and diabetes; and developing a widely used vaccine for hepatitis B and a high-speed ventilator used to keep premature babies alive.

"We clearly recognize the absolute necessity of animal research," said SFBR President Kenneth P. Trevett. "But a bare majority of the American public does," Trevett continued. "In a mere four years, support for the use of animals in biomedical research has declined, from 64 percent in 2004 to 54 percent in 2008.

"Our primates are essential for medical progress, as are mice, rats, guinea pigs, and opossums. Without them, we would be stripped of the very tools we need to open new paths of discovery and to challenge old dogma." ■

Publishing Productivity

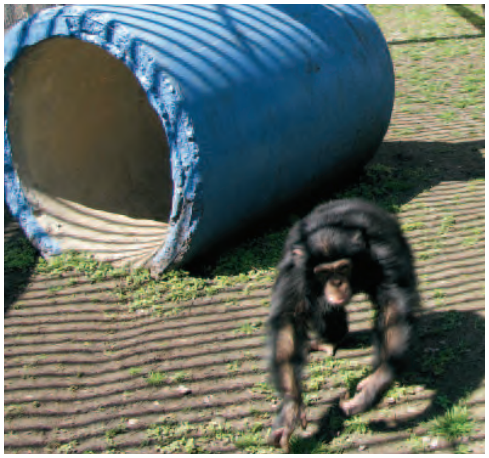
One of the telling ways to evaluate productivity in a research institution is to ascertain the number of publications authored by the faculty and accepted by peer-reviewed journals. Looking at this criterion, SFBR researchers are significantly increasing their productivity even though the total number of staff has not grown. The numbers for the last ten years are shown here.

Year	Number of SFBR publications
2000	95
2001	119
2002	106
2003	129
2004	121
2005	140
2006	131
2007	154
2008	129
2009	150

Environmental Enrichment Helps SFBR Primates

Exercising. Grooming. Eating a variety of foods. Watching television. Listening to music. Interacting with other animals. Manipulating toys. These are just some of the important elements of a carefully designed Southwest National Primate Research Center (SNPRC) program of environmental enrichment for chimpanzees, baboons, and monkeys that keeps the animals content and suited for biomedical research.

In addition to fulfilling the strong ethical commitment of SNPRC and SFBR to treat all animals well, the program serves a scientific purpose: healthy animals exhibiting normal behavior make the best research models.



Enrichment programs are important to maintain research animals, especially chimpanzees.

"People don't always realize that what is good for the animal is also good for science," said Corrine Lutz, Ph.D., SNPRC's director of Behavioral Services. This unit provides a wide range of stimuli and opportunities for the animals to display certain behaviors more common in the wild. The goal of the program is to provide an environment that encourages the expression of species-typical behaviors such as appropriate social interactions, locomotion, manipulation, and foraging, in a captive setting. The enrichment program is built on accumulated knowledge of the natural history of each species housed at SNPRC.

"Enrichment programs are important for two reasons," said SNPRC Director John L. VandeBerg, Ph.D. "First, we have a moral responsibility to ensure that animals used in research have stimulating environments that contribute to their psychological well-being. Second, animals that are environmentally deprived may develop abnormalities in their immune systems and in other physiological systems; animals with such abnormalities may not provide experimental results that are valid for translation to the normal human condition.

"Our philosophy is that the animals should be maintained under environmentally enriched conditions to ensure their own well-being and to ensure that the experimental results from them are valid for understanding the human condition. An appropriately enriched environment is necessary to ensure good science."

In some ways, animals take priority over humans at research institutions. "When I was at the University of Massachusetts, to save money, they would shut down the air conditioning in the offices on weekends," Lutz said. "But you don't shut down the air conditioning in animal areas. You're not allowed to do that. So some of the professors would sit in the animal housing corridors to do their work because it was too hot in their offices."

Lutz has a staff of five, including Maribel Vazquez, who specializes in chimpanzee enrichment and management; Steven Iredale, monkey enrichment and management; Sabrina Bourgeois, training; Kim Linsenbardt, behavioral management, and Heath Nevill, behavioral intervention.

With more than 3,500 nonhuman primates living at the SFBR campus, including the world's largest pedigreed baboon colony, enrichment is no small task. "We're responsible for the psychological well-being of basically all the nonhuman primates at the Foundation, which is a lot of animals," Lutz said.

And although nonhuman primates remain the focus of her programs, even the rodents and opossums at SFBR receive enrichment. For example, the lab mice receive nesting material to chew up, huts to crawl into, and places to hide, as they would in the wild.

Lutz and her staff are continually focused on improving life for the animals under their care. "Animals get good care here," she said. "I wouldn't want to be associated with a facility where they didn't."

For more information on the environmental enrichment program at SNPRC, please see the SFBR Web site at: **www.sfbr.org/SNPRC/primates_enrichment.aspx.** ■

SNPRC Uses a Variety of Methods to Keep Animals Healthy, Happy

SNPRC's Behavioral Services unit breaks down its primate enrichment program into five categories: social, physical, feeding, manipulative, and sensory.

Social enrichment is considered crucial because primates are social animals and need contact with each other. Social housing also gives them opportunities for common interactive behaviors, such as social grooming.

More than 90 percent of animals at SNPRC live in social groups or are socially housed. "Social enrichment is the most important thing we can do for animals," said Corrine Lutz, Ph.D. "And if they have a compatible partner, that in itself is more important than all other enrichments we can provide for them, combined."

Social enrichment is crucial because primates are social animals and need contact with each other.

The SNPRC pays close attention to compatibility among animals placed in groups for overall psychological well-being, as well as for their physical protection. "In the wild, if two animals start fighting, one individual can escape and run away, but in captivity, they don't have that opportunity," Lutz said. "So we have to be very careful about how we form groups to make sure that fighting doesn't occur and that animals don't get injured. It's much more important to pay attention to group dynamics in captivity."

Physical enrichment includes structures on which the animals can climb, as well as perches and swings. It also can include barrels hanging from chains to sit inside or swing in, tire swings, ropes, and chains to walk across. Such structures can also form visual barriers that provide privacy for animals in social groups.

The baboon corrals contain large culverts and climbing structures that also provide shade. The roofs of most chimpanzee housing areas are made of pipes so that the chimpanzees can swing by their arms, from one area to another.

All of the SNPRC's animals get some amount of food enrichment in addition to their nutritionally complete diet, which comes in biscuit form.

The staff has an opportunity for creativity when planning monthly menus. Chimpanzees are given items such as fruits and vegetables, as well as crackers, oatmeal, cereals, and grains. "If all they ate was monkey chow every day, I would think that would get a little boring," Lutz said. They also receive certain seasonal foods for variety, such as pumpkins in the fall, along with frozen fruit or drinks in the summer. During Fiesta week, the chimpanzees are often given piñatas.

Some of the foods are placed in devices that require the animals to spend time extracting the food, a common situation in the wild. Studies have shown that some animals prefer to work for food, as opposed to being given free food. This is similar to foraging for food in the wild.

The primates are also provided with objects to manipulate, including balls, chew toys and stainless steel rattles. The Behavioral Services staff makes many of these items, but also obtains them from pet-supply companies or from firms that specialize in primate products.

Chimpanzees are often provided with nesting materials, such as shredded paper or toilet tissue, to encourage nesting behavior as seen in the wild. To encourage additional activities, some chimpanzees are also provided with paint brushes, crayons, and paper.

Television falls into the category of sensory enrichment. TV mainly is used with animals that don't have access to the outdoors, such as those being treated for illness or new arrivals in quarantine. However, most chimpanzee enclosures allow for television viewing regardless of their situation. The animals get to watch a variety of shows such as children's programming, cartoons, and nature videos. "It's important to give them some stimulation, something additional to view," Lutz said.

Some of the chimpanzees simply enjoy watching television, even if they have outdoor access. "When they come inside, they may spend time watching it," she said. "We like them to have that option."

One group of researchers at the University of Massachusetts showed video of other monkeys, as well as television programs to groups of rhesus monkeys. "The researchers found that what kept the monkeys interested were videotapes containing

Corrine Lutz, Ph.D., displays animal enrichment items.

a high frequency of scene changes, so the monkeys actually watched soap operas more than video of familiar monkeys taken with a static camera," Lutz said.

Radio also helps to keep both the nonhuman primates and the caretakers entertained, she noted. "If we have the choice, we tend to play classical music for the animals, but not all of the caretakers like classical music," she said. "We need to keep both groups happy. However, the radios are turned off by the end of the day so the animals can sleep."

Lutz's staff also includes a full-time animal trainer who teaches animals to cooperate with the staff. Baboons, for example, need to be shifted out of the cage into a chute so the cage can being cleaned. Chimpanzees are similarly trained to be shifted from one location to another.

Some chimpanzees have been trained to present a body part for routine health checks. One way to do this is to set up a reward system that allows them to cooperate for a preferred food item such as a small box of raisins. Other training includes teaching some group-housed animals to engage in cooperative feeding. This encourages a dominant animal to allow others to get their food.

"The dominant animal learns that if he doesn't interfere with everybody else, he gets additional food," Lutz said. "For example, if he lets the other chimpanzees get a banana, he may get two bananas. In the wild, the dominant animals get priority access to food. Cooperative feeding allows everyone to get treats without conflict." ■

Cindy Calderon, Advocate for Animals and People, Keeps SFBR Up to Date on Latest Regulations

Long-time administrative assistant Cindy Calderon sees herself as an advocate for the animals at SFBR and the people who work with them. She thoroughly enjoys the role. And she also appreciates the important part she plays in keeping the Foundation in compliance with government regulations. It's a position that requires a highly organized person with a keen eye for detail.

Calderon, 54, spends much of her time coordinating the activities of the Institutional Animal Care and Use Committee, usually referred to as the IACUC. She works in administration primarily as assistant to Associate Scientific Officer Robert Shade, Ph.D., whose responsibilities include regulatory issues.

The IACUC reviews proposed and active research protocols and evaluates SFBR's animal care. The Foundation must file reports annually with the National Institutes of Health (NIH) Office of Laboratory Animal Welfare in order to maintain eligibility for federal research funds. That eligibility is essential to much of the research conducted at SFBR, home of the Southwest National Primate Research Center, where some 3,500 nonhuman primates and more than 2,000 other animals reside.

Calderon also finalizes the IACUC's reports and plays major roles in keeping SFBR in compliance with other regulatory agencies by coordinating the Biohazard and Safety and Recombinant DNA committees and filing their reports with the NIH Office of Biotechnology Activities.

She also helps to keep SFBR in compliance with the U.S. Department of Agriculture and the accreditation organization Association for Assessment and Accreditation of Laboratory Animal Care International, usually known as AAALAC.

In other words, she keeps a lot of plates spinning, while ensuring that SFBR remains in good standing. "Let's just say I like my job," said Calderon, a San Antonio native. "I think that my job is unique. There is no secretary-administrator out here who does what I do. I feel fortunate that I was given this opportunity."

She started out her career at a law firm after graduating from Providence High School, a private Catholic school for girls. She then earned an associate's degree from San Antonio College that qualified her to work as a legal assistant. When some of the attorneys split off to form a new firm, she took a position in SFBR's Virology Department in 1988, working for then department chair Gordon R. Dreesman, Ph.D.

Cindy is one of those people whom you can depend upon to do an outstanding job at anything you ask her to do.

– Robert Shade, Ph.D.

After Dreesman left the Foundation, Calderon moved over to administration in 1990, working for Shade, then chair of the Physiology and Medicine Department, when he took over responsibility for the IACUC. "Through all my changes in title, she has been my administrative assistant," Shade said. "Cindy is one of those people whom you can depend upon to do an outstanding job at anything you ask her to do. She's a very thoughtful, highly motivated person."

Calderon said she never tires of the IACUC and the meticulous paperwork it requires. No research protocol involving an animal can proceed without approval by the committee. She receives the submissions from researchers seeking IACUC approval and sits in on the committee's meetings and takes notes for its official minutes. "I love sitting in on the meetings because those are real brain-power meetings," Calderon said. "It's interesting to see how discussions go different ways sometimes, and then they come together in agreement. I guess that's what science is about."

And not every protocol gains approval from the IACUC, she said. "Nobody just goes out there and does whatever they want to with the animals," she said. "They have to send in an

appropriate application, and then the IACUC reviews this submission as a whole. They are extensive applications, detailing hypotheses and what's going to be done to the animals, adverse effects, procedures, and the outcomes."

IACUC Chair Anthony Comuzzie, Ph.D., had nothing but praise for the quality of Calderon's work. "You can't even begin to imagine how critical she is to what we do," Comuzzie said. "She's exceedingly knowledgeable and a real pleasure to work with. She's just on top of everything, and her organizational skills are phenomenal."

She also fulfills an important role in the monthly animal facility inspections that go into the required reports to the NIH. "One of the things I like to do when I'm around these inspections, is to pull the supervisor aside and say, 'OK, I'm not one with a whole lot of letters behind my name,' so they may feel more comfortable talking to me," Calderon said. "I say, 'Is there an issue that needs to be looked at kind of behind the scenes that we don't see? Is there something that we're overlooking?' A lot of times they feel comfortable telling me. Then, I'll bring it up at a committee meeting and have the committee decide if it's a legitimate issue or not."

Cindy Calderon

In her life outside SFBR, Calderon enjoys spending time at her family's condo on South Padre Island and involvement in activities with the St. Anthony Mary Claret Roman Catholic Church. Her church-related activities have included pilgrimages to Italy and Israel.

She is married to Ventura "Tito" Calderon, a U.S. Air Force Reserve training instructor and fire apparatus operator with the San Antonio Fire Department, which also was her father's employer. They have a 30-year-old daughter, Marcie, a 27-year-old son, Vincent, and five grandchildren. Cindy Calderon enjoyed having a close extended family while growing up in San Antonio and is pleased that her children also have the same type of bonds with their cousins.

Part of the satisfaction of her job at SFBR is knowing that she helps to keep the animals in good living conditions, she said, and the ability to contribute to improvements there through the IACUC and other regulatory activities.

Calderon also feels good about the high level of respect and caring that others at SFBR show for the animals. "The people who work with the animals have an interest in them," she said. "You really have to like animals to work out here, especially for staffers who have been here much longer than I have." ■

Year in Review

Continuing high quality research by faculty and a unique combination of scientific resources make the Southwest Foundation for Biomedical Research an international leader in making discoveries that are having a crucial impact on local and world health. With the leadership of Board Chair John R. Hurd, and the scientific vision of John VandeBerg, Ph.D., the chief scientific officer, and Department Chairs Jean Patterson, Ph.D., and Sarah Williams-Blangero, Ph.D., the Foundation has enhanced its intellectual capacity in 2009 to guide and conduct important infectious disease and genetic research.

John R. Hurd, chair of the SFBR Board of Trustees, with Robert M. Cavender, chair of the board's audit committee.

Several major events during the year marked SFBR's continuing success in guiding its growth. Highlights included appointing a national advisory board, receiving funding for a senior position in infectious disease research, securing funding through the American Recovery and Reinvestment Act (ARRA), advising a presidential panel on biosecurity, organizing an international meeting on the use of animals in research, and conducting important outreach to the San Antonio and scientific communities.

Advisory Board Named

SFBR President Kenneth P. Trevett announced the membership of a new national advisory board composed of individuals with outstanding credentials. The board will meet annually to advise the SFBR board of trustees and management on strategic issues.

Members include Claude Bouchard, Ph.D., executive director of the Pennington Biomedical Research Center in Baton Rouge; Richard Doughty, M.S., C.M.A., associate director of administration at the Oregon Health Sciences University and Oregon National Primate Research Center; James LeDuc, Ph.D., professor of microbiology and immunology and holder of Shope-Dunn Chair in Global Health and associate director of the Galveston National Laboratory at the University of Texas Medical Branch; Margaret Kripke, Ph.D., professor of immunology and, until recently, executive vice president and chief academic officer at the M.D. Anderson Cancer Center in Houston; Robert Mahley, M.D., Ph.D., president of the J. David Gladstone Institutes and professor of medicine and pathology at the University of California at San Francisco; and Kenneth Shine, M.D., executive vice chancellor for health affairs for the University of Texas System and professor emeritus and former dean of medicine at the University of California at Los Angeles, as well as former provost for health sciences there.

Infectious Disease Researcher

San Antonio's Ewing Halsell Foundation announced that it will donate $2 million to the Foundation to recruit a senior-level infectious disease researcher. "Existing and newly emerging infectious diseases are a world health crisis," said Trevett. "SFBR is uniquely situated with an outstanding staff

and extraordinary resources to address this problem. Funds for an additional senior researcher will be a big step in bringing new vaccine and therapeutic solutions to this major public health concern."

The recruitment will add a senior investigator to SFBR's Department of Virology and Immunology to serve as a mentor and role model, assist with the intellectual development of the department, and facilitate program enhancement.

Stimulus Funding

Supplemental funding of $5.6 million through the ARRA will support projects that include expanding a rhesus monkey colony, searching for candidate genes that influence body mass index, studying metabolic syndrome in Mexican-American children, pursuing AIDS research, and identifying the genes involved in schizophrenia.

Jean L. Patterson, Ph.D.

Biosecurity Panel

Jean L. Patterson, Ph.D., participated as a panelist for the Working Group on Strengthening the Biosecurity of the United States, a government-sponsored public consultation held in Bethesda, MD.

The working group was created by President Bush on January 9, 2009, through an executive order. The focus of the working group, which was co-chaired by officials from the Department of Health and Human Services and the Department of Defense, was physical and facility security and personnel reliability of those entities and persons who handle, store, or transport select agents. The working group reviewed existing policies and practices at federal and nonfederal facilities that deal with biological select agents and toxins.

Early in 2010, the working group issued a report recommending that researchers who work with the world's deadliest pathogens undergo more frequent security screening. It also stated that the need for redundant inspections from numerous agencies, with conflicting guidelines, should be evaluated because the process slows progress in developing countermeasures to a bioterrorist attack.

Outreach to San Antonio and Beyond

SFBR built strong relationships during 2009 with other research organizations to strengthen collaborations and enhance SFBR's visibility within the community. Foundation President Trevett serves on the executive committees of the United Way and BioMed/SA, the board of the Texas Research and Technology Foundation, and the advisory boards of the Southwest Research Institute and South Texas Accelerated Research Therapeutics.

The Foundation is an active member of the Association of Independent Research Institutes (AIRI) and participated in its 2009 annual meeting. SFBR's Gregory M.L. Patterson, Ph.D., served as co-chair of the meeting's program committee and was elected to the AIRI Board of Directors. SFBR also attended the annual meeting in Washington, D.C., of Research!America, a nonpartisan alliance in support of public education and advocacy to make health research a higher national priority. In addition, SFBR is a member of the Scientists' Center for Animal Welfare (SCAW). VandeBerg is a member of the SCAW Board of Trustees.

Trevett and VandeBerg hosted a visit by Rep. Lamar Smith during which they described the Foundation's major programs. They also appeared on the Saturday morning "San Antonio's Movers and Shakers" radio program to talk about the Foundation and its key role in improving local and international health.

SFBR opened its doors during the first three months of 2009 to 10 classes of high school seniors when the Southwest Foundation Forum hosted its annual tours for advanced biology and chemistry students. The students learned about the exciting possibilities of careers in science by viewing a video

Foundation President and CEO Kenneth P. Trevett addresses a gathering of donors at the house built by Tom Slick.

overview of the Foundation, visiting the AT&T Genomics Computing Center, and speaking with SFBR scientists working on hepatitis C, heart disease, diabetes, obesity, lung disease in premature infants, and other health problems. In addition, SFBR hosted tours for the Rotary Club of San Antonio and representatives from many local and national companies.

To aid in telling SFBR's story, the organization produced a fact card for its leaders and supporters to use in discussing the Foundation's accomplishments and current work with the public, policymakers, members of the press, and others. The SFBR fact card is an easily portable list to keep on hand at all times. It is available for download on the SFBR Web site.

Animal Research

VandeBerg co-chaired the organizing committee for the 3rd International Congress on the Future of Animal Research held in November in Bangkok, Thailand. The meeting brought together approximately 150 investigators and students from Asia, Europe, and North America who conduct biomedical research, and field researchers. Of particular importance were the interactions between those engaged in biomedical research and field research and the ways in which each of those areas can be strengthened by drawing upon knowledge gained from the other. Participants identified ways in which field research could be used to inform biomedical research and noted the critical importance of protecting natural populations of nonhuman primates. The conference was supported in part by The John Newman Family Charitable Trust of the San Antonio Area Foundation.

On the topic of animal research, an op-ed piece by VandeBerg in the December 19 issue of the *San Antonio Express-News* noted that "we are losing the war with extremist groups who are convincing the American public that animals are not needed to advance medicine and science." VandeBerg cited a recent poll, which found that 64 percent of Americans supported the use of animals in research in 2004. By December 2008 only 54 percent supported their use. VandeBerg described the important advances in modern medicine that would not have been possible without animal research in the areas of polio, hepatitis A and B, human papilloma virus, stroke, and AIDS.

Staffers Remembered

In 2009, SFBR mourned the passing of two highly valued staff members, Jonathan S. Allan, D.V.M. (see page 10) and Lesley Meade. She began at SFBR in 2001 as a temporary secretary. Meade joined the Human Resources Department in 2002 as a full-time employee and later worked for the Office of Sponsored Programs and the Purchasing Office.

A native of England, Meade met her husband, Dan, when he was stationed there with the U.S. Air Force. At SFBR, she served as a key member of the Employees Activities Committee, and was responsible for reviving its newsletter in 2007 and making SFBR logo items available for sale. Meade loved to read, cook, and sew. She is survived by her husband and two sons, Daniel and Christopher.

Looking Ahead

SFBR's leadership has enabled the organization to thrive during an era of limited funding from the National Institutes of Health. The Foundation continues to study and look for ways to attract top notch scientists, improve its physical plant, and create optimum conditions in which to conduct first rate science. As SFBR moves forward into 2010 and beyond, it will continue to identify ways to build on its record of research accomplishments and to enhance its ability to advance the health of people everywhere. ■

New Grants and Contracts

Federal Research Grants and Contracts

Grant Sponsor, Title, SFBR Principal Investigator, Length of Grant	Total Amount to SFBR
National Institutes of Health Southwest National Primate Research Center Mr. Kenneth Trevett, 5 Years	$36,323,157
National Institutes of Health Genetics of Bone Structure and Metabolism Dr. Michael Mahaney, 5 Years	$3,378,666
National Institutes of Health Genetic Epidemiology of Chagas Disease Progression Dr. Sarah Williams-Blangero, 4 Years	$3,152,612
National Institutes of Health/Crucell Advanced Development of Multivalent Filovirus (Ebola and Marburg) Hemorrhagic Fever Vaccine Dr. Jean L. Patterson, 3 Years	$2,743,389
National Institutes of Health Discovery of Functional Variants in Type 2 Diabetes Genes in Mexican Americans Dr. Ravindranath Duggirala, 5 Years	$2,377,576
National Institutes of Health Southwest National Primate Research Center, supplement Mr. Kenneth Trevett, 1 Year	$2,260,961
National Institutes of Health Southwest National Primate Research Center, supplement Mr. Kenneth Trevett, 2 Years	$1,703,813
National Institutes of Health Expression-Based Empirical Candidate Genes Influencing Body Mass Index Dr. Joanne E. Curran, 2 Years	$1,684,480
National Institutes of Health/Baylor College of Medicine Obesity and Diabetes Familial Risk in Hispanic Children Dr. Anthony Comuzzie, 4 Years	$1,272,854
National Institutes of Health/Wright State University Genetic Architecture of a Human Dentognathic Complex Dr. Sarah Williams-Blangero, 4 Years	$1,220,930
National Institutes of Health Epithelial Cells as Mucosal Adjuvant for Lifelong Immunity Dr. Marie-Claire Gauduin, 1 Year	$847,754
National Institutes of Health/University of Texas Health Science Center San Antonio Effects of Aging on Vaccine Efficacy in Baboons Dr. Karen Rice, 3 Years	$646,187
National Institutes of Health/Yale University Cellular and Molecular Transport in Mucus Dr. Luis D. Giavedoni, 5 Years	$617,660
National Institutes of Health/State University of New York Downstate Medical Center Collaborative Study on the Genetics of Alcoholism Dr. Laura Almasy, 5 Years	$530,914
National Institutes of Health Development of Nonhuman Primate Models for PSA Biology Studies Dr. James Mubiru, 3 Years	$480,971
National Institutes of Health/University of Texas Health Science Center San Antonio Beta Cell Adaptation to Stress in Baboon Pancreas after Partial Pancreatectomy Dr. Anthony Comuzzie, 2 Years	$353,178

Grant Sponsor, Title, SFBR Principal Investigator, Length of Grant	Total Amount to SFBR
National Institutes of Health/Evanston Northwestern Healthcare Research Institute Joint Mapping of Genome-Wide Gene Expression and Association in a Schizophrenia Data Set Dr. Harald H. H. Göring, 2 Years	$282,212
National Institutes of Health Diet and Genotype in Primate Atherosclerosis (supplements to Promote Diversity in Health-Related Research) Dr. John L. VandeBerg, 2 Years	$193,292
National Institutes of Health/Medical College of Wisconsin Pharmacogenetics of Obesity and Endocannabinergic Modulation Dr. John Blangero, 4 Years	$189,311
National Institutes of Health The Metabolic Syndrome in Mexican American Children, supplement Dr. Ravindranath Duggirala, 2 Years	$145,554
National Institutes of Health/Seattle Biomedical Research Institute Vaccine Efficacy of Modified HIV Envelopes, supplement Dr. Marie-Claire Gauduin, 1 Year	$110,000
National Institutes of Health/MicroBiotix Carbocyclic Nucleosides as Therapeutics for Ebola Infections Dr. Jean L. Patterson, 2 Years	$87,693
National Institutes of Health/Nationwide Children's Hospital Post HCV Replication and Immunity Dr. Kathleen M. Brasky, 1 Year	$86,730
National Institutes of Health Dengue Virus Determinants of Virulence and Transmission, supplement Dr. Rebeca Rico-Hesse, 1 Year	$82,413
National Institutes of Health/Joslin Diabetes Center Mapping Genes for Proteinuria in Type II Diabetes Dr. Ravindranath Duggirala, 2 Years	$64,961
National Institutes of Health Efficacy Study of Ebola Vaccine, supplement Dr. Jean L. Patterson, 6 Months	$63,491
Department of Defense/Applied Nanotech Photoscrub Challenge with *B. anthracis* and *B. subtilis* Dr. Ricardo Carrion Jr., 5 Months	$54,134
National Institutes of Health/Quality Biological, Inc. Non-human Primate Luminex Assays Dr. Luis D. Giavedoni, 3 Months	$50,000
National Institutes of Health/University of Texas Health Science Center San Antonio Institute for Integration of Medicine and Science: A Partnership to Improve Health Dr. Jera Pecotte, 2 Years	$49,344
National Institutes of Health/University of Texas Health Science Center San Antonio Multimodal Evaluation of Networks Underlying Photosensitive Epilepsy in Baboons Dr. Jeff T. Williams, 1 Year	$44,889
National Institutes of Health Mapping Drug Resistance Genes in *Plasmodium falciparum*, supplement Dr. Timothy J. C. Anderson, 1 Year	$44,774
National Institutes of Health/University of Texas Medical Branch Galveston Obstetric-Fetal Pharmacology Research Units Network, supplement Dr. Karen Rice, 1 Year	$34,545

Grant Sponsor, Title, SFBR Principal Investigator, Length of Grant	Total Amount to SFBR
National Institutes of Health/Baylor College of Medicine Improving the Safety and Efficacy of Gene Therapy with HDAd Dr. Karen Rice, 1 Year	$32,000
National Institutes of Health/Stanford Research Institute Broad-spectrum Agents for Prophylaxis and Treatment Against Bacterial Threat, supplement Dr. Ricardo Carrion Jr., 2 Years	$13,260
National Institutes of Health Assessment of Ebola Virus Neutralizing Antibodies Dr. Jean L. Patterson, 4 Months	$10,650
National Institutes of Health Cytokine 20-plex Luminex Assays Dr. Luis D. Giavedoni, 2 Months	$4,494
TOTAL FEDERAL RESEARCH GRANTS AND CONTRACTS	**$61,238,849**

Miscellaneous Research Grants and Contracts

University of Texas Health Science Center San Antonio Effect of Exentide on Insulin Secretion and Beta Cell Mass in Normal and Type 2 Diabetic Baboons Dr. Anthony Comuzzie, 2 Years	$649,387
Norwegian University of Science and Technology Genome Wide Association Scan for Pre-eclampsia Dr. Eric Moses, 1 Year	$162,500
Norwegian University of Science and Technology Genome Wide Association Scan for Pre-eclampsia Dr. Eric Moses, 1 Year	$114,400
University of Texas Health Science Center San Antonio MRI Imaging in Marmosets Dr. Kathleen M. Brasky, 9 Months	$74,615
Menzies Research Institute Statistical Analysis of Genetic Data from Tasmanian Cancer and Multiple Sclerosis Dr. Jac Charlesworth, 1 Year	$19,189
University of Texas Health Science Center San Antonio Development of an Off-Pump Coronary Artery Bypass in NHP's to Evaluate the Effect of Botox on the Flow of Arterial Grafts, supplement Dr. Karen Rice, 2 Years	$18,542
Wake Forest University Personnel Funding Dr. Anthony Comuzzie, 1 Year	$9,241
Baylor College of Medicine Hemofiltration as Immune Modulation in Gene Therapy Dr. Karen Rice, 4 Months	$9,182
Trinity University Development of Hemispheric Specialization in Capuchin Monkeys Dr. Karen Rice, 6 Months	$8,380
TOTAL MISCELLANEOUS RESEARCH GRANTS AND CONTRACTS	**$1,090,436**

Grant Sponsor, Title, SFBR Principal Investigator, Length of Grant	Total Amount to SFBR
Philanthropic Research Grants	
Robert J. Kleberg Jr. & Helen C. Kleberg Foundation Monodelphis Research Program Dr. John L. VandeBerg, 1 Year	$398,032
Robert J. Kleberg Jr. & Helen C. Kleberg Foundation Chagas Disease: An Emerging Fatal Disease in Texas Dr. John L. VandeBerg, 1 Year	$321,743
American Heart Association and the Max and Minnie Tomerlin Voelker Fund Genetic Analysis of the Aminopeptide Genes Residing at a Novel Pre-eclampsia Susceptibility Locus on Chromosome 5q Dr. Matthew Johnson, 4 Years	$308,000
Richard & Dianne Azar Cystinosis Research Program Dr. Eric Moses, 2 Years	$212,518
Cowles Memorial Trust Postdoctoral Fellowships Dr. Gregory M. L. Patterson, 1 Year	$164,159
Coates Foundation Genetic Dissection of Cystinosis: An Innovative Program for Novel Mechanism/Gene Discovery Dr. Eric Moses, 1 Year	$94,445
Cowles Memorial Trust Postdoctoral Fellowship Dr. Claire Bellis, 1 Year	$52,708
Max & Minnie Tomerlin Voelcker Fund Endothelial Differentiation of Baboon Embryonic Stem Cells Dr. Qiang Shi, 1 Year	$50,000
Max & Minnie Tomerlin Voelcker Fund Development of a Baboon Model of Liver Cancer Dr. Robert E. Lanford, 1 Year	$50,000
Max & Minnie Tomerlin Voelcker Fund The Effects of Diet and Obesity on Prostate Specific Antigen (PSA) in Non-human Primates Dr. James Mubiru, 1 Year	$50,000
USAA Foundation Liver Cancer Model Dr. Robert E. Lanford, 1 Year	$50,000
Max & Minnie Tomerlin Voelcker Fund Genetics of Serum Phytonutrients and Their Relation to Cardiovascular Disease and Metabolic Syndrome Risk Factors in Mexican American Children: A Pilot Study Dr. Vidya S. Farook, 1 Year	$49,952
Max & Minnie Tomerlin Voelcker Fund Epigenetic Variation Contributing to Myelodysplastic Syndrome and Acute Myeloid Leukemia Dr. Melanie Carless, 1 Year	$49,891
Joe and Jessie Crump Foundation Genetic Variation Associated with Acute Myeloid Leukemia and Myelodysplastic Syndrome Dr. Melanie Carless, 1 Year	$47,700
Max & Minnie Tomerlin Voelcker Fund Dissecting the Genetics of Osteoarthritis Dr. Lorena M. Havill, 1 Year	$47,078

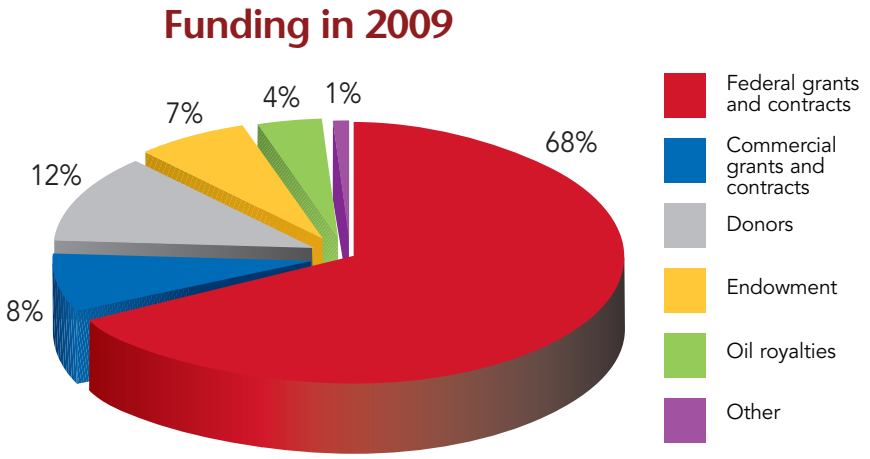
Grant Sponsor, Title, SFBR Principal Investigator, Length of Grant	Total Amount to SFBR
Society for Women's Health Research Determination of Sex Differences, Heritability, and Sex-specific Genetic Effects on Knee Arthritis in a Nonhuman Primate Model Dr. Lorena M. Havill, 1 Year	$45,424
Southwest Foundation Forum Are "gamma delta tau" Cells HIV/SIV Reservoirs and Targets for HIV Treatment Strategies? Dr. Vida Hodara, 1 Year	$35,000
Southwest Foundation Forum Measuring the Mutation Rate in Malaria Parasites Dr. Timothy J. C. Anderson, 1 Year	$35,000
Southwest Foundation Forum Characterization of the Neurite Outgrowth Gene, SLITRK6, and its Role in Human Brain Structure Dr. Melanie Carless, 1 Year	$34,871
Southwest Foundation Forum Identification and Characterization of Micro RNAs Influencing Dyslipidemia in Baboons Dr. Genesio M. Karere, 1 Year	$28,993
Southwest Foundation Forum A Pilot Assessment for a CVD Genetic Study in Parsi Zoroastrians in Texas Dr. Venkata Saroja Voruganti, 1 Year	$27,260
Southwest Foundation Forum A Baboon Model for Genetic Mechanisms of Reduced Bone Formation in Space Dr. Lorena M. Havill, 1 Year	$24,690
San Antonio Area Foundation Exploring the Novel Metabolic Actions of Glucose-dependent Insulinotropic Polypeptide (GIP) Dr. Paul Higgins, 2 Years	$17,413
American Heart Association/Baylor College of Medicine Hepatocyte Gene Therapy with Helper Dependent Adenoviral Vectors Dr. Karen Rice, 9 Months	$15,210
Take Off Pounds Sensibly/University of Wisconsin Analysis of LDL and HDL-cholesterol Sizing for Obesity and Metabolic Syndrome Dr. David Rainwater, 3 Months	$7,000
TOTAL PHILANTHROPIC RESEARCH GRANTS	**$2,217,087**
TOTAL COMMERCIAL RESEARCH GRANTS AND CONTRACTS	**$2,378,857**
TOTAL RESEARCH GRANTS AND CONTRACTS	**$66,925,228**

Construction and Renovation Grants

National Institutes of Health Establishment of a SPF Rhesus Macaque Colony, supplement Dr. Larry B. Cummins, 2 Years	$524,290
National Institutes of Health Improvement of Facilities for Nonhuman Primate Research Dr. John L. VandeBerg, 1 Year	$404,289
TOTAL CONSTRUCTION AND RENOVATION GRANTS	**$928,579**
TOTAL GRANTS AND CONTRACTS AWARDED TO SFBR IN 2009	**$67,853,807**

Sources of SFBR Funding in 2009

As did much of San Antonio, the Southwest Foundation for Biomedical Research successfully weathered the economic downturn in 2009. This was made possible by the efforts of SFBR staff members who kept expenses under control and by the continued strong support of the donor community. With the new grant awards made possible by the American Recovery and Reinvestment Act in late 2009, SFBR is positioned to have strong financial performance in the next several years.



Ernst & Young's audit of SFBR's operations for the fiscal year ending December 31, 2009, is expected to be completed in late spring 2010. As in prior years, no material adjustments are expected. Because of the audit schedule, the figures displayed here have not been independently audited. The final audit for 2009 will be available in the summer of 2010. Copies may be obtained through the Foundation's Vice President for Finance and Administration and Chief Financial Officer, Jeannie Frazier (210-258-9404).

In 2009, 68 percent of SFBR's $48 million in funding came through highly competitive, peer reviewed research grants and contracts from the National Institutes of Health (NIH) and other federal agencies. Meanwhile, the organization's scientific expertise and extraordinary research resources were instrumental in securing commercial contracts with biotechnology firms and pharmaceutical companies equal to 8 percent of SFBR's operating revenue.

As the accompanying chart shows, philanthropy continues to play the vital role in SFBR research that Tom Slick envisioned when he founded the organization in 1941. Altogether, philanthropic sources provided more than 23 percent of the Foundation's funding, making SFBR and its donors true partners in scientific progress.

Financial support from donors enables SFBR to attract and retain the world's top scientists, provide researchers with state-of-the-art technology and laboratories needed to advance their work, and launch innovative pilot projects to explore new ways to understand and eliminate diseases. Private gifts also leverage significant additional investment by allowing investigators to compete successfully for prestigious foundation grants that do not cover the full cost of research. Important SFBR sources of philanthropic funding include the Golden Circle, the Founder's Council, the Southwest Foundation Forum, and annual required contributions from Argyle members.

In addition to these current contributions, SFBR research is supported through annual earnings on previous philanthropic gifts to the Foundation's endowment, accounting for 7 percent of revenue. At the end of fiscal year 2009, SFBR's endowment was valued at $85.4 million, a remarkable increase of more than $16 million from year-end 2008. SFBR's investment strategy, guided by the Investment Committee of the Board of Trustees, was instrumental in achieving this result.

In 2009, SFBR also received significant royalties on oil and gas properties that had previously been contributed by donors. This revenue was critical to Foundation programs, making up 4 percent of total revenue at a time when other sources were under stress.

With continuing prudent financial management, a strong donor base, new grant revenues from the recovery act, and the rebound in the endowment value, SFBR looks forward to a strong financial forecast in the coming years. ■

Unaudited Consolidated Balance Sheets (as of December 31, 2009)

ASSETS

	December 31 Unaudited 2009	2008
Cash and cash equivalents	$ 7,212,063	$ 10,188,035
Receivables:		
Accounts	545,457	357,352
Contracts receivable from research projects	7,314,452	8,850,918
Amounts due on authorized grants in aid:		
National Institutes of Health	28,219,182	22,914,981
Other	8,166,642	10,108,548
Prepaid expenses and supplies	221,345	161,245
Contributions receivable	321,534	999,227
Assets limited as to use:		
Assets designated for capital expenditures and research:		
Cash	3,751,329	3,751,329
Investments-Fair Market Value	88,140,447	70,362,244
Assets limited as to use — other	21,272	48,715
The Argyle land, buildings, and equipment (net of accumulated depreciation of $3,142,674 and $2,934,755 in 2009 and 2008, respectively)	3,982,193	3,675,859
Property, plant, and equipment:		
Land	374,530	374,530
Buildings and improvements	47,324,757	46,826,320
Fixtures and equipment	49,729,180	47,954,877
	97,428,467	95,155,727
Less allowances for depreciation	54,438,534	49,345,766
	42,989,933	45,809,961
Construction in progress	183,392	–
	43,173,325	45,809,961
Total Assets	**$191,069,241**	**$177,228,414**

Unaudited Consolidated Balance Sheets (as of December 31, 2009)

LIABILITIES AND NET ASSETS

	December 31 Unaudited 2009	2008
Accounts payable and accrued expenses:		
Trade accounts	$ 2,418,320	$ 2,081,414
Accrued wages, vacation and other liabilities	2,214,923	2,278,866
Convertible promissory notes and accrued interest	5,715,400	4,042,500
Accrued liabilities — related party	–	675,000
Post-retirement benefits	749,268	651,608
Unearned contract revenue from research projects	6,664,122	6,257,962
Amounts unearned on grants in aid:		
Advance collections	366,908	250,942
Uncollected authorized grants in aid	32,101,400	27,053,625
Total Liabilities	**$ 50,230,341**	**$ 43,291,917**
Net Assets:		
Unrestricted net assets	94,161,667	91,264,288
Temporarily restricted net assets	19,774,998	15,904,979
Permanently restricted net assets	26,902,235	26,767,230
Total Net Assets	**$ 140,838,900**	**$ 133,936,497**
Total Liabilities and Net Assets	**$ 191,069,241**	**$ 177,228,414**

Why Support SFBR?

It's a fact of life that grants and contract income are insufficient for SFBR to achieve its important mission. Since the organization's founding, giving has played the role of a powerful enabler of progress, making philanthropy one of the cornerstones of the success of this institution. Here are a few examples of how your financial support can make all the difference to SFBR scientists:

- Leverage. On average, for every $1 contributed, SFBR scientists gain another $8 in competitive grant support, making Foundation researchers among the most productive anywhere.
- Critical programs and projects. Research grant and contract funding is the majority funding source of SFBR, totaling about 75 percent of revenue. The remaining support must come from endowment income and current donations.
- Key research ventures. Donations fund recruitment of key scientists and pilot studies, each representing strategies that encourage bold initiatives by new and existing faculty.
- Extraordinary resources. SFBR has a history of developing rare scientific resources. The AT&T Genomics Computing Center and the BSL-4 maximum containment laboratory are examples of such resources funded by donations.
- Technology. Research is made more productive by the latest in technology. The higher cost of the newest technology usually requires philanthropic support.

You can make a difference. Unlike some research organizations, SFBR does not have patient or tuition revenue to fund capital and operating expenses. Donations are critical for funding new programs and capital purchases at SFBR.

SFBR excels as a center for scientific research because of the philanthropic support of donors. Will you consider becoming a partner in progress? In addition to donor opportunities highlighted in this report, such as the Golden Circle, The Argyle, Founder's Council, and the Southwest Foundation Forum, the Foundation offers opportunities for legacy gifts, capital and endowment gifts, and memorial and honor gifts.

For more information on any of these giving opportunities, please contact SFBR's Vice President for Institutional Advancement, Corbett Christie, at (210) 258-9870 or cchristie@sfbr.org, or visit the Web site at **www.sfbr.org** and click on "Support SFBR." ■

Southwest Foundation Forum

The Southwest Foundation Forum ushered in 2009 under the leadership of President Laura Moorman by sponsoring student tours at the Foundation. Scores of seniors from advanced placement biology and chemistry classes at eight San Antonio area high schools were given the unique opportunity to see science in action, including firsthand descriptions of research and facilities by faculty members from the Department of Virology and Immunology and the Department of Genetics.

The Forum is a women's organization founded in 1970 to support SFBR through community relations, volunteer services and fundraising.

We encourage science students and education through annual Science Education Awards. Given jointly by the Forum and the V.H. McNutt Memorial Foundation, the awards offer an opportunity for Bexar County area teachers to apply for grants to benefit their school's science programs. The goal is to assist in the purchase of teaching materials for creative, hands-on projects. This year marked the 17th anniversary of the awards.

Terry Gouger

The awards are given to area high school science departments to support new programs that further students' interest in, and knowledge of, science. This year, six high school science departments from five area schools received $20,000 in awards. Those who did not win an award but were reviewed received a generous stipend of $200 for their school's science program; and all applicants received a personal stipend of $50 from the L.D. Ormsby Foundation. The panel of judges was composed of SFBR scientists; Valerie Guenther, representing V.H. McNutt Memorial Foundation; and Forum volunteers.

- First place: $7,000 to Alan Spannagel of Byron P. Steele II High School for Physical Properties of Plastic.
- Second place: $4,500 to Brenda Carrillo of McCollum High School for Building Biological Concepts.
- Third place: $3,500 to Pete Alaniz of South San Antonio High School for Investigating Pond Environmental Systems.
- Fourth place: $2,500 to Marvin Rudd of Byron P. Steele II High School for Polymerase Chain Reaction and Comparative Protein Analysis Lab.
- Fifth place: $1,500 to Layne Steinhelper of Keystone High School for Soil Microplates/Microplate Reader.
- Honorable mention: $1,000 to Colin Lang of Alamo Heights High School for Aeroscience Studies.

The spring brought another sellout luncheon featuring guest speaker Amy Hardberger of the Environmental Defense Fund in Austin. Her lecture, "Wind, Sun, and the Future of Energy," informed members and their guests about the cost effectiveness of tapping into various alternative sources.

The most anticipated Forum event was the annual fund-raising Gala. The 2009 "Out Of Africa" theme evoked the plains of the Serengeti. Mwendo African drummers welcomed guests as they entered a tent designed with swags of mosquito netting. Raffle items included an African Safari. More than 500 guests attended, bringing in revenues of $175,000. Proceeds from the event were awarded in the form of grants to the six SFBR scientists whose projects are listed on page 36 of this report.

As the dust settled on the gala, new Forum board members took their positions for 2009-2010. I am very humbled to be following in the footsteps of Laura Moorman, and the Forum thanks her for her continued support and friendship. By tradition, the outgoing president leaves a gift of remaining funds to the Foundation in the name of the Forum board. Laura's gift was $14,779.45 for the purchase of two thermocyclers that read viral states in the BSL-4 laboratory.

Starting off my tenure, a group of board members and friends attended the Tom Slick Exhibit at the McNay Art Museum and listened to Catherine Cooke share the fascinating adventures of her uncle and SFBR founder who had a wide range of scientific interests. Touring his art collection helped us to better understand Tom Slick and his visionary thinking in the arts as well as science.

SFBR President and CEO Kenneth P. Trevett accepting Gala check from Suzanne Dabous, M.D., Karen Lee Zachry and Laura Moorman.

For the seventh year in a row, through the kind generosity of Julian Gold, "Ladies Night Out" was a great success once again. With 10 percent of all sales from the evening event going to the Forum, a check was presented in the amount of $2,500. Many thanks to La Fonda Restaurant for providing food and libations.

One benefit of membership in the Forum is that members enjoy the opportunity to learn more about how science affects their own lives. One of these opportunities came through this year's "Insider's Tour," which was formerly called the "Evening Tour" until it moved to the morning hours, a time frame that enabled participants to take a tour of the Southwest National Primate Research Center. As in the past, members also toured the BSL-4 lab, the AT&T Genomics Computing Center, and other areas of interest. Afterwards, members were treated to a lunch that hosted a scientist at each table so that members could get a more personal take on what is happening at the Foundation.

The calendar year came to an end with the Fall Lecture Luncheon. Clinton Baisden, M.D., spoke on "Choices We Make: The Latest Science on Living the Longest in Good Health." With 160 members and their guests listening, Baisden humorously explained the difference between biological age and chronological age.

There is so much more going on than can be put on these pages. Every board member continues to improve areas such as membership, the Web site, publicity, and the list goes on. I would like to end by saying that through contributions for small SFBR pilot studies made by the Forum in 2009, we helped develop more than $6 million in new grants. With statistics like that, I cannot wait to see what we as a group can do as we begin our next 40 years in 2010. Happy Anniversary!

Terry Gouger

Founder's Council

The Founder's Council encourages today's young leaders to leave a legacy inspired by SFBR founder, Tom Slick. Founder's Council members provide support for the Foundation's research process through membership contributions. In establishing the Southwest Foundation for Biomedical Research, Tom Slick envisioned "a great center for scientific progress through biomedical research." Today, the young men and women of the Founder's Council, whose ages of 25 to 46 reflect Slick's visionary initiative to found the institution at age 25, provide financial support to SFBR's scientific research. Members' annual donations of $135 per individual, or $195 per couple, fund competitive grants to SFBR researchers for the purchase of much-needed scientific equipment.

In 2009 more than $38,000 in grants were awarded to:

- Luis Giavedoni, Ph.D., for an instrument to obtain biopsies from macaques for research in infectious diseases, including AIDS.
- Kathy Brasky, V.M.D., for an instrument that increases the efficiency of diagnostic tests for SFBR animals used in all fields of research.
- Melanie Carless, Ph.D., for a cell culture incubator that improves the maintenance of cell lines required for molecular genetic studies on heart disease, obesity, diabetes, high blood pressure, and metabolic disease.
- Katy Freed, Ph.D., for an instrument that will increase the efficiency of processing thousands of samples in cystinosis and other research.
- John Garza, Ph.D., for an instrument used to increase the purification of crystals, an important step in developing diagnostics and therapeutics for potential bioterrorism agents, such as Marburg and Ebola viruses.
- Anthony Griffiths, Ph.D., for an instrument that increases efficiency in research on herpes B that is fatal to 80 percent of untreated individuals and could be weaponized for use against masses of people.
- Krishna Murthy, D.V.M., Ph.D., for a device used to increase the efficiency in cleaning surgical instruments used in his research on infectious diseases such as AIDS, hepatitis C virus, and West Nile virus.

Recipients of Founder's Council grants.

Founders

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- Ricardo Carrion, Ph.D., for a micro-centrifuge that spins research samples at high speeds to separate the component materials. The equipment will be used in highly infectious disease research at the Foundation's BSL-4 facility.
- Qiang Shi, Ph.D., for a computing system that will improve the current process of capturing microscope images for cardiovascular research.

Under the leadership of Founder's Council President Ed Hart, the group also hosted several events to advance awareness of SFBR and its research efforts. Lecture luncheons featuring SFBR scientists focused on topics such as the future of genomics research and the effects of diet on obesity and diabetes, while an evening of "Dining and Discourse" allowed members to visit with several of the Foundation's leading researchers and learn about their current research. The Founder's Council also enjoyed informal social mixers to network and meet researchers and other members. SFBR is stronger because of the visionary young leadership fostered through this energetic and enthusiastic group of supporters. ■

The Argyle

For more than 50 years, The Argyle, a stately Southern mansion and unique private club, has been devoted exclusively to the support of the life-saving efforts of the Southwest Foundation for Biomedical Research. Founded in the 1950s and located just three and a half miles from downtown San Antonio, the 1,400-member club serves as a bond between one of our country's leading independent research institutions and those who give time and money to support it.

Originally built in 1854 as the headquarters of a horse ranch which extended from downtown San Antonio to the town of Boerne, some 30 miles distant, it was an outpost of Texas hospitality. Through a succession of owners, it epitomized the pleasant ways and good living of the storied South. It was purchased in 1884 by two Scotsmen, who added the third floor and opened a hotel. They named it The Argyle because the surrounding rolling hills reminded them of their native Scotland. It was a happy event that The Argyle came into the capable hands of the fabulous Miss Alice O'Grady around the turn of the century. The Argyle was legendary throughout the world for its fine table and illustrious guests.

In 1954, Harold Vagtborg, Ph.D., Southwest Foundation's first president, and Betty Slick Moorman, sister of founder Tom Slick Jr., discussed ways to interest more people in the Foundation's work and to create a broader and more permanent base of support for its research programs. Betty Moorman suggested the establishment of a high-caliber club whose members would make an annual contribution to the Southwest Foundation, and thus The Argyle of today was formed.

Restored in 1956, The Argyle stands as a symbol, both of its rich past and of progress toward a healthier tomorrow for the global community. Formed by persons deeply interested in the Southwest Foundation for Biomedical Research, the club is a meeting place for men and women of science and civic leaders who have dedicated personal resources for the advancement of the Foundation.

The Argyle is the scene of many grand occasions such as weddings and family events, as well as meetings of numerous Southwest Foundation support groups and trustees. One of the most popular initiatives is a series of "Fireside Chats," held for Argyle members and guests. This program allows members to meet with Foundation scientists in a social setting to enjoy a conversational exchange of ideas and information regarding the scientists' research efforts. In 2009, six of these popular "chats" were hosted.

The year kicked off with Laura Almasy, Ph.D., who spoke about her studies of genetics and their influence on mental health. In March, Robert E. Lanford, Ph.D., recapped the most current advances in the battle to cure hepatitis C, which afflicts about 4 percent of the adult population in the United States. In April, Foundation President and CEO Kenneth P. Trevett spoke on "Envisioning the Future." Members were treated in September to a fast-paced photographic presentation by Sarah Williams-Blangero, Ph.D., titled "Around the World in 80 Projects." In October, Andrew Hayhurst, Ph.D., described his research into defenses and vaccines for pathogens of bioterrorism. The year was capped by a November lecture from John Blangero, Ph.D., director of the AT&T Genomics Computing Center, on "What Our Genes Tell Us."

Argyle members continue to live up to their vision of honoring the past while at the same time changing the future through their philanthropic investments in the Southwest Foundation. ■

Credits

The SFBR Annual Report is a publication of the Southwest Foundation for Biomedical Research.

Editor: Joseph Carey, SFBR Vice President for Public Affairs

Writer: Joel Williams

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Photography Credits

Qiang Shi, Ph.D.: cover

Robert E. Lanford, Ph.D.: page 4

Susan Mooberry, Ph.D.: page 7

Melanie Rush Davis: page 9

Clem Spalding: pages 15, 17, 23

Geno Loro Jr.: page 18

Larry B. Cummins, D.V.M.: page 22

Maribel Vazquez: page 24

Larry Walther: pages 10-14, 16, 20, 21, 26, 28-31, 41-43, 45, and 47-50

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