The Philological Society of Texas

PROCEEDINGS

2005

The Philosophical Society of Texas

PROCEEDINGS

OF THE ANNUAL MEETING

AT GALVESTON

DECEMBER 2–4, 2005

LXIX

AUSTIN
THE PHILOSOPHICAL SOCIETY OF TEXAS
2005

The Philosophical Society of Texas for the Collection and Diffusion of Knowledge *was founded December 5, 1837, in the Capitol of the Republic of Texas at Houston by* Mirabeau B. Lamar, Ashbel Smith, Thomas J. Rusk, William H. Wharton, Joseph Rowe, Angus McNeill, Augustus C. Allen, George W. Bonnell, Joseph Baker, Patrick C. Jack, W. Fairfax Gray, John A. Wharton, David S. Kaufman, James Collinsworth, Anson Jones, Littleton Fowler, A. C. Horton, I. W. Burton, Edward T. Branch, Henry Smith, Hugh McLeod, Thomas Jefferson Chambers, Sam Houston, R. A. Irion, David G. Burnet, and John Birdsall.

The Society was incorporated as a non-profit, educational institution on January 18, 1936, by George Waverly Briggs, James Quayle Dealey, Herbert Pickens Gambrell, Samuel Wood Geiser, Lucius Mirabeau Lamar III, Umphrey Lee, Charles Shirley Potts, William Alexander Rhea, Ira Kendrick Stephens, and William Embrey Wrather. On December 5, 1936, formal reorganization was completed.

The office of the Society is located in Austin, Texas at P.O. Box 160144, Austin, 78716.

Edited by Terri Killen, Ashley Leiter, and Julie Pennington.

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The Philolophical Society of Texas

"Medicine and Medical Policy in the 21st Century" was the topic of the 169th anniversary meeting of the Philosophical Society of Texas, held in historic Galveston on December 2–4, 2005. Headquartered at the Hotel Galvez, most of the meetings and presentations occurred at the University of Texas Medical Branch-Galveston. A total of 267 members, spouses, and guests attended. The Society President, Harris L. Kempner Jr., organized the program. The meeting began on Friday with a reception and dinner held at the Hotel Galvez. President Kempner announced the thirteen new members of the Society and presented them with their certificates of membership. The new members are John W. Barnhill Jr., Jack Blanton Jr., Paul Burka, Blandina Cardenas, Lee Cullum, Pat Frost, James R. Huffines, F. Scott McCown, Helen Carol Nicklaus, Caren Harvey Prothro, Andrew Sansom, Ann Stuart, and E. Lee Walker.

On Friday evening, David La Vere was awarded the 2005 Philosophical Society Award of Merit for his book, *The Texas Indians*, published in 2004 by Texas A&M University Press. The award is presented annually for a book on Texas, either fiction or non-fiction. LaVere signed books on Saturday at Levin Hall.

The topic of "Medicine and Medical Policy in the Twenty-first Century" was discussed at Levin Hall on the campus of the University of Texas Medical Branch during the day on Saturday. That evening a reception and dinner were held at the Tremont House, followed by an optional visit to the annual Dickens on the Strand in Galveston's Strand Historic District.

The annual business meeting was held on Sunday morning. The names of Society members who had died during the previous year were read: Marguarite Johnston Barnes, John L. Margrave, George C. McGhee, D.J. Sibley, Charles C. Sprague, Robert S. Trotti, Frank E. Vandiver, and Stuart Wolf.

Secretary Ron Tyler announced that with the thirteen new members, Society membership stood at 190 active members, 73 associate members, and 57 emeritus members, for a total membership of 340.

Officers elected for the coming year were: S. Roger Horchow, president; Isabel Brown Wilson, first vice-president; Boone Powell, second vice-president; J. Chrys Dougherty III, treasurer; and Ron Tyler, secretary.

After the business meeting, a lively discussion ensued on the topic of "Texas Medicine and Medical Policy in the Twenty-first Century." At its conclusion, 2006 President S. Roger Horchow declared the meeting adjourned until December 1, 2006, in Dallas.

Welcome and Introduction

Harris L. Kempner Jr.

Good morning and welcome to the University of Texas Medical Branch in Galveston for the opening session in our program on "Medicine and Medical Policy in the 21st Century."

I'll be introducing the moderator, Dr. Ron Carson. He is, somewhat to my great pride, the Harris Kempner Distinguished Professor for the Medical Humanities. Those of you who knew Dad know that this is the kind of professorship he would have most been delighted to have had. And we in the family have been delighted with the way Ron has performed for twenty years, or twenty-one years, as such.

Some brief announcements: David La Vere will do a book signing during the break this morning at Levin Hall here, and there will be books on sale about Galvestoniana and Texas history also at the breaks.

Medical Humanities is not a specific course on this campus. It is part and parcel of everything that we do here. Some of us looking on from the outside make damn sure it is because it has to do with making sure that those who go through medical school training also have some sense of people as human beings, rather than as diseases or as their specialty.

Ron and the Institute have done an enormous amount of work in medical ethics and other things. He's an ideal person to run a program which will cover the gamut from policy to patients. So without further ado, I will turn this over to Ron Carson.

Old Red (c. 1894). *Courtesy Rosenberg Library.*

HEALTHCARE FOR THE 21ST CENTURY

RONALD A. CARSON[1]
Moderator

Thank you, Shrub. Good morning, all. I don't need really to tell you—but I will this morning—who Kay Bailey Hutchison is. She's from here, and I mean literally *here*. She grew up in La Marque and went to U.T. and graduated from the law school there as well. She was twice elected to the House of Representatives in Texas, and in 1990 was elected as Texas State Treasurer.

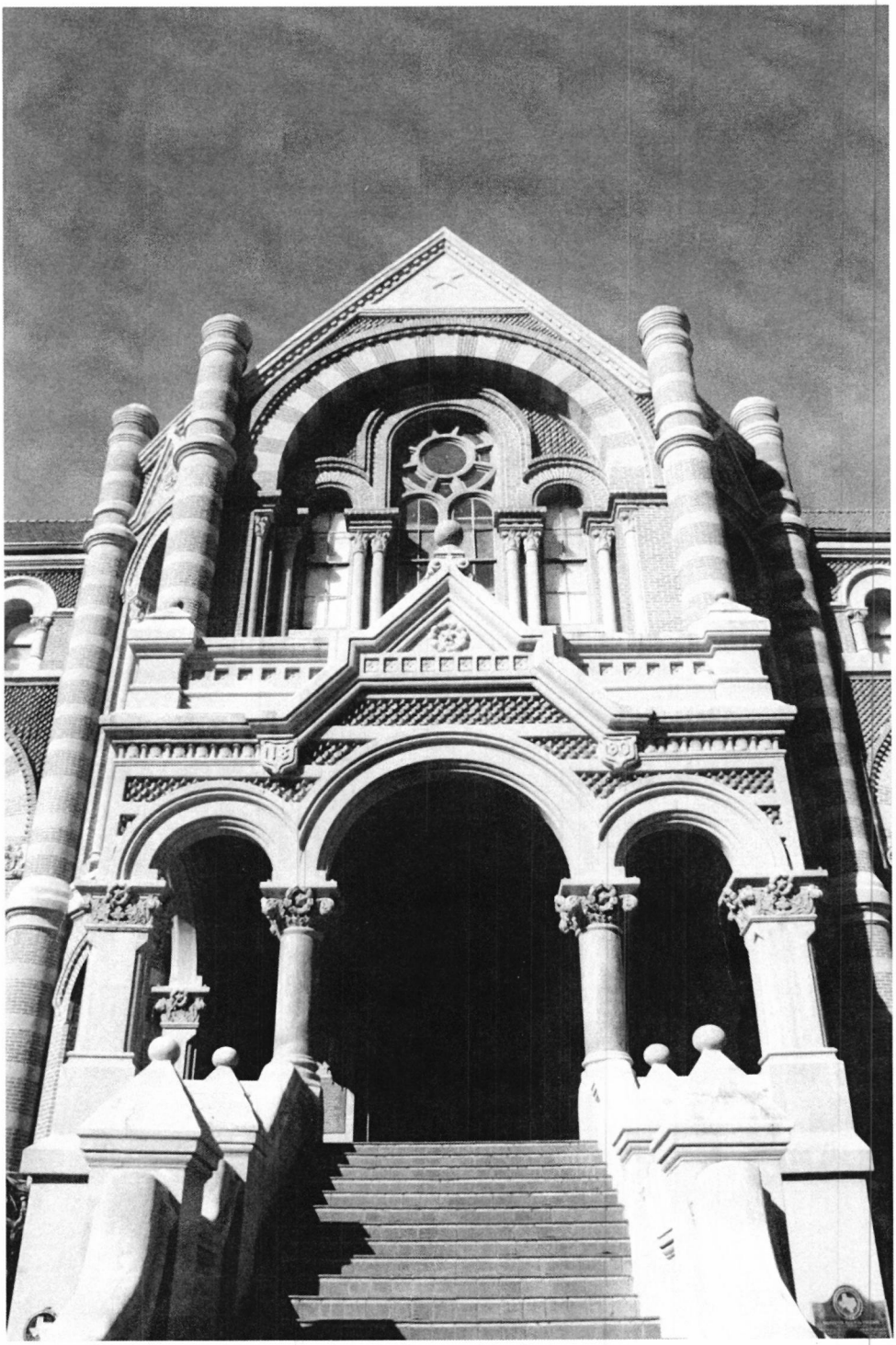
Then in 1993 she was elected as the first woman to represent Texas in the U.S. Senate. Seven years later more than 4 million Texans reelected her to a second full term—at that time the largest number of votes ever garnered in the state. She's the fifth highest ranking Republican senator.

Her many areas of specialty include defense and foreign policy—and here she's a leading voice on national security issues and serves as a U.S. delegate to the Helsinki Commission. She played a major role in drafting the landmark security bill in the wake of the September 11 terrorist attacks.

She chairs the Science and Space Subcommittee whose chief responsibility is to oversee NASA. The historic education reform bill signed into law in early 2002 includes important provisions written by the Senator.

We welcome you, Senator, to speak on "Can Texas Maintain Its Leadership in Health-related Research."

[1] Ronald A. Carson, Ph.D. is the Harris L. Kempner Distinguished Professor and former director of the University of Texas Medical Branch's Institute for the Medical Humanities.



Old Red restored front view (2011). *Courtesy Lisa Reyna.*

Can Texas Maintain Its Leadership in Health-Related Research?

Kay Bailey Hutchison[2]

You said earlier that I was from Galveston. Not only is that true, but I was born literally right across the street. This is my home, and it is a wonderful place. I want to thank our hosts from Galveston for a terrific program; I wish that I could stay here the whole day. I am so pleased that I was asked to speak to you today about medical research in Texas. Texas is on the map already in this arena, and I think we have the building blocks in place to stay right on top with the very best in our country and in the world.

Let me first say that I came in from Washington, a city where it can be hard to find your way around. It was laid out by the French architect Pierre L'Enfant. The location of Washington is thought to have been decided on during an intense negotiation between Alexander Hamilton and Thomas Jefferson. Although they probably possessed the best mind from the North and the best mind from the South, they may not have managed to incorporate the best of both regions in the city. Washington seems to me to be a city that combines southern efficiency with northern hospitality.

In the area of medical research, I am really excited about the opportunities in Texas; what we have done and what we are doing. Many of you know that I am on the Appropriations Committee. When I first went on the committee, I started looking very closely at what was happening in scientific research. At that time, we were working to double the budget of National Institutes of Health, and I wondered where Texas stood in terms of federal research dollars. So I asked, and the answer was disappointing. Texas was fifth in the nation in federal research dollars going to our institutions of higher education, and by some measurements we were sixth. I could understand that California would come in number one—

[2] Kay Bailey Hutchison has represented Texas in the U.S. Senate since 1993, where she is also serving a third term as Vice Chairman of the Senate Republican Conference, remaining the fifth-highest ranking Republican Senator.

they are a whole third bigger than we are, and they have more institutions of higher education. I could even understand that New York was number two because they've been at this longer. But fifth or sixth for Texas, I could not understand.

I began to look at what I could do to help increase our federal research funding. I brought the heads of our research universities and medicals schools together in Washington to meet with department heads from the federal agencies that were doing the most research. I knew that these department heads would be able to give us the spark we needed because they knew what their research priorities were. We had these summits for five straight years, rotating the people with whom we met. We met with the Department of Defense, the National Science Foundation, the Department of Energy, the National Institutes of Health, the National Cancer Institute, NASA, and others.

Over those five years we started to develop a strategy that would target the centers of excellence at our institutions of higher education. I did not want everybody to try to be the University of Texas or Rice University or Texas A&M. I wanted to build specific centers of excellence, encouraging one of our universities to become better than UT in a particular field or better than Rice in another field. I wanted to bring the different centers of excellence together. I asked our institutions of higher education to stop thinking of themselves as being in competition with each other. The University of Texas and A&M should not be competitors, but collaborators. MD Anderson and UT Southwestern should be collaborators. We needed our centers of excellence to come together and think of themselves as representing Texas, not individual institutions—we needed to think of ourselves as Team Texas.

Once we focused on our centers of excellence, then we started to build them up. No university in America receives more federal agriculture research dollars than Texas A&M because they are the best at what they do. NASA's biomedical research facility is located at Baylor College of Medicine. We had the two Nobel laureates who pioneered the area of nanotechnology right there at Rice University, and Rice adopted the team concept immediately. I asked Dr. Malcolm Gillis, then the president of Rice University, if he would lend the credibility of those Nobel prize winners to other Texas universities and help us build a nanotech research consortium. He said, "Absolutely," and Dr. Richard Smalley, whom we tragically lost to cancer just this year, and Dr. Robert Curl became the heads of two major consortia.

SPRING, which focuses on the materials aspect of nanotechnology, has received over $20 million from the Department of Defense. This consortium of the University of Texas at Austin, Rice University, the University of Texas at Dallas, and the University of Texas at Arlington has been a great coalition; it is in the forefront of nanotech materials research. Later, we also brought UT Pan American, UT Brownsville, and Texas Tech University into the program. This groundbreaking nanotech work is helping

us support our soldiers, creating body armor that is stronger and lighter. This is invaluable in places like Iraq when it is 110 degrees in the summer. It can also create lighter and stronger materials for airplane construction.

The Alliance for Nanohealth, in Houston, is the biomedical aspect of the nanotechnology initiative. It utilizes small particles in the blood to detect and help cure disease. There are so many new things that can be done now and a lot of what we are putting together in Houston will keep us in the forefront. This is how we build on our centers of excellence. For instance, Texas A&M Veterinary School does a lot of research on animals, so they have teamed with Dr. Michael DeBakey at Baylor College of Medicine to use dogs to test the heart machine that keeps patients alive while they are waiting for their transplants. Baylor and Texas A&M came together with their two centers of excellence to build something even better.

Another national player is right here—in Galveston—where you are sitting. Thanks to the vision of Dr. John Stobo, Galveston is the only city in America that has one of the two national Level 4 Biocontainment Labs and also has one of the regional biodefense research centers. No other city has both. The UT Medical Branch is a leader in America in bioterrorism research. Dr. Stobo is already talking about avian flu and early detection efforts, so again he is ahead of the pack.

Recognizing our potential, we went on a mission to get more federal research dollars for Texas. I didn't want to say, "Hey, we're Texas, we're the second-largest state in America and we deserve more." No, I wanted to do it on the merits; I wanted to get our great minds to hear what the federal research priorities were because I knew we could do more. I knew that if we could just get that information to our institutions of higher education then we would have a natural advantage. In fact, UT Southwestern in Dallas has more Nobel laureates than any other medical school in America. They have four—four at one medical school in Texas. MD Anderson gets more federal money from the National Cancer Institute than any other institution in the United States. Dr. Julio Palmaz at the University of Texas at San Antonio medical school invented the heart stent used to treat coronary artery disease.

We were already doing a lot to support research in Texas, but I just knew that if we focused on the federal priorities as they opened up that we could do better; and we have. We are now third behind only California and New York, and we are not far behind New York. I think with Dr. Stobo leading the way on these biocontainment labs that we have a chance to go into second place, which is where we should be. California does have more tier one institutions, but that's a different subject for a different day.

One of the offshoots of this research effort was suggested by Neil Lane of Rice University at one of our summits. I asked the group if there was anything else that we ought to be doing, and Neil told me that the best researchers in Texas don't really know each other. The people at MD Anderson, Baylor, and UT Houston did not know what UT Southwest-

ern was doing; they did not know what UT San Antonio was doing. Our researchers need to know what's going on at other institutions. Dr. Lane suggested that we have a meeting with all of the members of the national academies in Texas. I thought it was a great idea. We set up an advisory committee that was headed by two of our Texas Nobel laureates, Dr. Michael Brown and Dr. Richard Smalley. They are the founding co-chairs of The Academy of Medicine, Engineering, and Science of Texas, or TAMEST.

To be a member of TAMEST, you have to be a member of the national academy in your field because the academies elect members based on rigorous peer assessment. The academy's third annual meeting will be in Houston this January. Each of the 236 members of the academy may bring one protégé, a young researcher who is doing good research. The members, including Texas's eleven Nobel laureates, hear presentations on research currently ongoing in the state. This has already created more alliances and more collaboration because we have a central place for the best minds in our state to meet.

The academy's numbers are growing because more scientists have been elected to the national academies and we are showing researchers that Texas is the place to be. It is a place that supports research, supports academics, and supports our science base. Going to one of those meetings is energizing for me. I understand about half of it, and I just love the enthusiasm of the members. Of course, they understand all of it.

Can Texas maintain its leadership in medical research? Yes it can, and here's how: A lot goes into it, but the basic concept is teamwork. Other places may be somewhat ahead of us in putting all of these pieces together, but we are making swift progress. Across the United States, universities are performing research in partnership with private industry that brings in more money, fueling more research. American universities have taken in more than $1 billion in revenue from licensing the products they helped create. New drugs, new agricultural products, and high-tech components can all become moneymakers for a university.

Across the country, 425 new startup companies have formed from university research. Many universities negotiated equity in these companies, and they have since sold that equity for a profit with all of the money going back to research. The model for the future is partnerships with private industry.

Such partnerships return to their academic institutions a percentage of the profits from the products they create. This money can be used as a recruiting tool. When researchers do work in Texas, they will be able to gain financially from it. In general, people who are doing this research could make a lot more money in the private sector–the doctors in our medical schools especially. Financial incentives can be very helpful in recruiting top notch researchers, and we want to bring in the best people.

Stanford and Harvard are now pursuing these partnerships, and they have created university research parks that are hotbeds for intellectual

curiosity. In Harvard's case, the pharmaceutical giant, Merck, is 50 feet away from Harvard Medical School's newest 400,000-square-foot research facility. At Stanford they focus on a lot of cutting-edge research because they are well-placed geographically within the high-tech industry. Hewlett Packard, Cisco, and Yahoo are all at Stanford's research park, and they were all founded by Stanford graduates and professors.

We are in the beginning stages of this model as well. Two examples of success are the University of Texas Southwestern Medical Center and UT Medical Branch. UT Southwestern formed a licensing agreement that provides them with royalties from a calcium supplement called Citracal. Most women know that Citracal is an excellent calcium supplement, and it is good for men, too. Citracal is also contributing to UT Southwestern's next research project. UT Southwestern has now negotiated over 350 licensing agreements in the U.S. and abroad, generating over $91 million in licensing revenue.

UT Medical Branch is entering this market as well. They've formed 10 partnerships, including one with Dowpharma and one with Hewlett-Packard. They are forming partnerships to develop new vaccines, and they will set up a rotating fund to help build their research power. By leveraging corporate capabilities, we can do a lot to enhance the strength of our institutions. We can also do a lot to enhance the capability of our institutions to attract more research dollars through philanthropy.

MD Anderson is now in the process of building a research park. I got involved because John Mendelson came to me about the importance of finding a sanctuary for research. There happened to be a military reserve base between MD Anderson and Old Spanish Trail, a total of 116 acres, and John asked me to find out if MD Anderson could buy it from the federal government. I looked into the matter and created what I think is a win-win situation. The location of the base no longer made sense. When it was built, I am sure it was way outside of town, but now it is right in the middle of economic development. Ellington Air Force Base is several miles away and was in danger of being closed during the base-realignment process. We needed to be sure to save Ellington for a number of reasons. It is a good base for security for the Houston Ship Channel chemical complex. I thought if we could put the Navy, Marine, and Army reserve units at Ellington and turn it into a joint base with the Air Force, it would be good for Ellington, and it would be great for Houston and MD Anderson.

As chairman of Military Construction Appropriation Subcommittee, I knew that the Department of Defense could sell excess property if they agreed to a move of a base. Since the Department already had land at Ellington, and added space for training, it was very appealing to move the facilities and put the money to better use. I was also able to get the money from the Military Construction Appropriations Subcommittee to start the program at Ellington for the reserve units right away. Now, MD Anderson has 116 new acres to construct a research park that will attract private industry partnerships.

Philanthropy comes into play here as well because the Red McCombs Foundation has generously donated $30 million for a cancer research facility that will attract private partnerships as well as great researchers. The Kleberg Foundation has created another center for molecular markers that will be housed in the research park. We are really beginning to build on the university research-park model, and I think it is going to make a huge difference in our progress into the next phase of our research initiative. Boston's academic institutions generate $1.6 billion per year in biomedical funding—that's about sixty percent more than what comes into Houston. At present, they produce ten times as many companies from those efforts as we do in Houston. But soon, we will have the same capacity as Harvard.

We are also doing some great research on Gulf War Syndrome. We are the best in the country in this field. One in seven soldiers who were deployed during the first Gulf War came back with conditions that were hard to pinpoint but very debilitating. For a long time, the Department of Defense wrote it off as psychosomatic symptoms or post-traumatic stress disorder, but the medical signs suggested it was more than psychosomatic. It was afflicting people the same way as Lou Gehrig's disease. Ross Perot funded a $5 million project at UT Southwestern to equip Dr. Robert Haley as he searched for a cause for these conditions. In a study of these veterans, Dr. Haley found brain damage in some of the veterans that was similar to damage caused by exposure to sarin gas and other chemical weapons. Others had no symptoms. Many of the unaffected veterans turned out to have a certain enzyme in their blood that the affected veterans did not. If this enzyme is indeed the difference, now we might be able to find treatments or even a cure.

We have made great progress, but we can do more. The next step will require the teamwork of our universities to attract researchers and private industry. We need to greatly expand our research parks and licensing agreements. Clearly, the way to attract researchers is to give them the best labs and equipment to do their research, and we can do that in a lot of ways. Philanthropy is one way, and we have very generous people in Texas. The federal government is another, and I have certainly jumped in to help on the Gulf War Syndrome project, the nanotechnology consortia, and other projects. I am also working with the Department of Energy to make sure we have the medical imaging equipment that we need to keep our researchers in the forefront.

Commitment from the state government should be another resource. The state of New York and the city of New York are very aggressive. The California state government is also aggressive, and we need to match it. We need to show that there is a state commitment as well as a federal, local, and philanthropic commitment to our research institutions.

Let me just close by saying that there are also opportunities for us to bring more of our universities into top tier status, especially with the centers of excellence concept. Texas State University in San Marcos has the

very best geography program in America. I learned this from the chairman emeritus of National Geographic as he was establishing the Gilbert Grosvenor Center for Geography Education.

We can build on this success with centers of excellence at other Texas universities. If we develop an expertise and keep nourishing it, then success will breed success. I think we have a lot of opportunities, and we must have more top tier universities in Texas if we are going to remain in the forefront. I think our medical schools are gems. They are top tier, and I am going to keep working to build on that status.

Can Texas maintain its leadership in medical research? Yes. With Texas teamwork—which is what we do well—we can do it. Thank you.

Discussion:

SENATOR JUDITH ZAFFIRINI: Senator Hutchison, my question is related to your topic. Can Texas maintain or expand its leadership role in stem cell research?

SENATOR HUTCHISON: This is such a new and growing field. I would say that the field is wide open. And I believe that it is essential that we be in this field.

Now, once again, California is out front. The people of California held a referendum, and they voted for $3 billion specifically to fund stem cell research in the state of California. That's a commitment that no other state has matched, so they're going to be in the forefront.

Many of our key people have told me that we could have a brain drain in Texas if we don't have some outlet for stem cell research. It can be accomplished in several different ways. It can be done with all private money. That would allow our researchers to go forward with private money with people who want to support it, and that's where philanthropy would come in. However, it is important for us to keep our best researchers connected to our universities. That is an issue to be addressed by the state legislature.

I think that there are ways that we can keep high ethical standards–which we must do–and also keep our best minds looking at stem cell research. As of today, the research community believes that the embryonic stem cell has the best capability to form itself into healthy bones, blood, pancreas, or whatever is the ailing organ. The embryonic stem cell has so far shown that it is more adaptable than an adult stem cell.

This is probably a better question for the experts to address, and I would hope that they would. From what I've learned the research is very new and they don't have 10- and 15-year progress reports, so I don't think we know for sure yet all of the components here.

I think that you could keep high ethical standard by maintaining what we have in place today—not encouraging people to create embryos to

destroy them, which I think would be a terrible, horrible, ethical lapse. If there's no encouragement for an industry that would create embryos to destroy them, you would have 100,000 to 200,000 stem cells from which you could do a lot of experimentation, and there would not be any incentive for the destruction of those embryos. That is one way that we could try to address this ethical issue, which is very real and very valid to address, as we look at the different components and perhaps even come up with a way in the embryonic stage to take from an embryo without destroying it. That is something that is very much a possibility. If that could be the case, then there wouldn't be an ethical issue because there would then be no incentive for destroying an embryo.

This is a new field, and I appreciate State Senator Judith Zaffirini bringing that out because it will be very important for the state legislature to make some of these decisions. I do hope that we can find the right ethical path that would keep our researchers' capabilities to pursue the very best use of these embryonic stem cells to try to save lives, because we know that they have a huge potential.

DR. KEN SHINE: I just wanted to let you know that the Texas Academy, in collaboration with the University of Texas, will for the first time next year have a mid-year conference located here in Galveston, April 5 and 6. And, not surprisingly, the chair of the planning committee is Jack Stobo. And Stan Lemon, who we'll hear from, is helping with this.

It's a very important statewide activity looking at the development of new agents to deal with microbes and vaccines. The attempt will be to not only look at the science but to look at the connection between the research and what the private sector would like to do in terms of making investments.

Tom Cassidy has been very supportive of this, and we're hoping that this will be an annual mid-year event. We've already talked to Baylor. If it's successful in 2006 they will sponsor it with the Academy in 2007. I wanted you to know that some of the work that you've done on the Academy is now bearing fruit beyond the annual meeting.

SENATOR HUTCHISON: I'm very happy to hear that because I think the more we can have all of our best researchers come together and learn what's going on, I think you'll have more collaboration, more ideas, and more opportunity to get research grants from either the private sector or the federal government. I'm really very happy and look forward to our January meeting very much.

DR. THOMAS BARROW: Senator, first I want to introduce myself to some of the people here. I'm Dr. Thomas Barrow. I am not a medical doctor. I'm a geologist, petroleum engineer, and member of the National Academy of Engineering.

I've also been for 20 years on the board of Baylor College of Medicine.

I've been vice chairman of that board. I've been on the Texas Medical Center's board and on the executive committee, so I'm very familiar with what goes on in some of these areas. I would like to thank you for all the help you have been to the medical profession and to the medical schools and centers in this state. I think you've done a marvelous job.

In having been a former trustee at Stanford and knowing what they did, eliminating the Department of Geography over my objection, I'm glad that you found out where the center is. I would urge all of you, as I have for many years, to support our senator. She's doing a great job and I'm very appreciative that she's here with us today. Thank you.

SENATOR HUTCHISON: Thank you.

MR. JIM GEORGE: I'm Jim George from Austin, Senator. What percentage of the federal expenditure is the medical research proportion? And how has that changed over your tenure in the Senate, if it has?

SENATOR HUTCHISON: I can't tell you the percentage, but I can tell you that we doubled the National Institutes of Health (NIH) budget over five years from 1999 to 2003. Now we're in the $28 billion range. We have made significant increases in the medical research portion of the federal budget.

We are in the process of doing the same thing right now with the National Science Foundation. We've gone from $2 billion to almost $6 billion this last year.

The place that we are really lagging in America—not Texas, but in America—is our science and engineering base. We are focusing on how to get better math and science teachers in our high schools so that students have the prerequisites to earn science and engineering degrees from our universities.

The place where America has its biggest problem and where we are behind the rest of the world in every test is our K-12 education. We are not preparing our young people to get the college degrees that are necessary for the jobs for the future. This is something that I think Congress and the President must address. I think we are making great strides in the medical area, and that's why I think Texas needs to be jumping in now to be competitive, because the money and the emphasis are there.

For those of you in academia, we must strengthen our K-12 programs, which necessitates more qualified teachers. We're looking at giving competitive scholarships to students who will get degrees in science and engineering and give five years to teach in high schools. We need to give scholarships to try to encourage our best people to go into teaching in high school so that these young people will be prepared for college.

If you rated our institutions of higher education in America against the rest of the world, we're the best. People still come here to get their higher education degrees because we're the best. The problem is a number of the

people getting the degrees are discouraged from staying here, and they go home to countries like India and China. They're using their skills, learned here, at home instead of staying here and increasing our overall productivity, and we're not preparing our students to be competitive. The bottom line is, in the medical area I think we're in pretty good shape, and that will continue.

MR. SHRUB KEMPNER: Senator, Shrub Kempner from Galveston. I was struck by the logic of your bringing the institutional heads to Washington to talk to the various research centers and find out what their new research emphasis would be. I wonder if you are continuing that cycle around a second time, and, if so, whether they had changed their priorities—to the extent you know—whether they had actually changed their priorities from the first time around and what's next.

SENATOR HUTCHISON: We have not had a summit for two years. We had it for five years and we covered the major areas, and we have not had one for the last two years. The TAMEST/Texas Academy meetings have given us more of an opportunity to cross-fertilize our academics. I did a survey of our heads of institutions to see if they thought that it was time for another one, and so far they have not. If there ever is an impetus to have another one I will.

In fact, I think the next one really should be going back to the Science Foundation, DARPA and the Department of Defense and delving into their newest things. They have a huge research arm in the Department of Defense that's very successful. It, too, could be very lucrative for us. We have a lot of defense research, but we could do even more.

One other thing that I think is significant is that Dr. Andrew von Eschenbach—the head of NCI, the National Cancer Institute—has just gone over to be the acting director of the FDA. Dr. von Eschenbach is from MD Anderson. His concept is to stretch our research dollars by doing more public-private partnerships in the National Cancer Institute as well, to make the private research dollars go farther.

Frankly, the private companies are doing less research than they used to because their litigation expenses are overwhelming some of their research capabilities. The head of a major pharmaceutical company told me that his research dollars and his litigation dollars were about even. That makes me sad because we ought to be spending more on what can produce for the future.

So they're cutting back, and now the federal government is stepping up. I think public-private partnerships can be very helpful in maintaining research, because frankly, in the national sense, we have more competition from foreign countries due to our restrictions.

For example, Michael DeBakey told me that he can't test his heart pumps on humans because of FDA restrictions. He does his testing in France. They are doing a lot of innovation in France, Germany, other

European countries, and China because we have such severe restrictions and high litigation costs.

We need to be looking at that as well as one of the ways that we can pursue more innovations so that we get the licenses to make the products. We want those products to be made in America because that means jobs for America. Stem cell research is another area where we could lose a lot to foreign research because it's more open there. We've got to always be aware of where we can do better.

DR. CARSON: This has been, I know you will agree, very informative. Senator, we thank you for your fine work on behalf of the state and the nation. The future looks bright for research in Texas.

SENATOR HUTCHISON: It does. Thank you.

HEALTHCARE FOR THE 21ST CENTURY

DR. CARSON: Our next speaker is Dr. John Stobo. Dr. Stobo began his medical career at the Mayo Clinic, and from there went on to University of California at San Francisco where he was researcher at the Howard Hughes Medical Institute.

Then in 1985 he returned to Johns Hopkins, where he had done his earlier studies, as the William Osler Professor of Medicine and Physician-in-Chief of the Johns Hopkins Hospital.

Dr. Stobo has been involved in many leadership capacities nationally—the American Board of Internal Medicine. He's been committed—deeply committed over many years to, for example, eliminating barriers to access for patients who are underserved or uninsured.

He came here to UTMB eight years ago at a time of great fiscal difficulty in medical schools across the country and led this institution—and has continued to lead it over the eight years with progressive and enlightened views about where medicine and health care ought to be as we proceed through the 21st century.

And his topic this morning is Healthcare in the 21st Century. Jack?

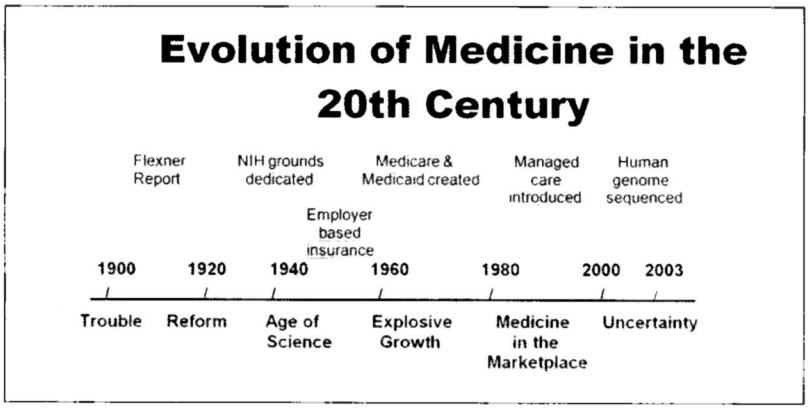
• • •

JOHN D. STOBO[3]

The topic this morning is Healthcare in the 21st Century. And I want to start out with a disclaimer. Given the rapid change that's occurring in healthcare it's almost impossible to predict with certainty the future of healthcare. I know that if somebody asked me when I started my medical career in the sixties to predict what medical will look like in the year 2000 there's no way I could have predicted all the changes that would have occurred and what medicine in 2000 would have looked like.

When I was an intern and a medical student, peptic ulcers were something you treated surgically. Now we know that peptic ulcers are caused by bacteria and can be treated with an antibiotic. We couldn't have envisioned magnetic resonance imaging, CAT scans, the onset of diseases like AIDS and SARS—just very difficult to predict with certainty the future of medicine. But what I'd like to do this morning is talk about some of the things I see as shaping the medical landscape over the next several years.

[3] Dr. John D. Stobo is the President of the University of Texas Medical Branch at Galveston.



In order to predict what medicine may look like in the future it's important to understand where medicine has come in the United States over the past decade. And if one goes back to the turn of the century—entering the 20th Century—in fact, the epicenter of medicine in the world was not in the United States. If one warranted—had the most advanced training or education in medicine—if one wanted to see the most advanced research and education or the most advanced clinical activities in medicine, one went to Germany or France. Indeed, medical education in the United States was pretty abysmal. There were 157 schools of medicine, schools of medicine educate doctors. Almost all of them were proprietary, that is, they were run for a profit. The professors lectured for the fees, only lectured for the fees that they got from the students. There were no laboratories. Medicine was taught only in the classrooms. And the entire length of medical school was four months. And if one could afford to buy a degree—or purchase a degree one got a degree in medicine. There were no licensing requirements.

Around the turn of the century a few schools, the University of Michigan, Harvard, Johns Hopkins, University of Pennsylvania, understood the poor medical education in the United States and made a commitment to advance medical education. And in this context they formed a contract with society. They said to society, "We promise you the highest quality and most advanced medical education in the world." And society said in turn, "If you deliver on that promise we will afford you certain rights and privileges, like the right of self-governance, high place in society, et cetera." And indeed, that started around 1900. Abraham Flexner was commissioned by the Carnegie Foundation in 1908 to assess the state of higher education, including medical schools in the United States and Canada. He published a scathing report in 1910 called the Flexner Report which pointed to the deplorable conditions of medical education in the United States. He also pointed out schools that exemplified the best in medical education, like Hopkins, Michigan, Pennsylvania, and Harvard.

And gradually things changed. The number of medical schools decreased from 157 to well under 100. Proprietary medical schools were

done away with. Licensure came into being. The length of medical school went from four months to four years. Laboratories were introduced. And the whole quality of medical education really changed, and with this medical care and medical research. And this led to the preeminence of the United States in medical education.

Over the past year there have been several landmarks. The National Institutes of Health that Senator Hutchison referred to, the federal agency that funds biomedical research was established after the 1940s. During the Second World War was the beginning of employer-based insurance. The War Labor Board during the Second World War said it was unfair for companies to compete by offering higher wages, that is, because of the labor shortage they said it was unfair for companies to woo employees away from another company by offering higher wages. And they standardized wages companies could pay. But they didn't say any thing about standardization of benefits. So what companies did to attract employees was to provide insurance, particularly health insurance, as an inducement to move from one company to another. And this was the beginning of what's called employer-based insurance, which is the foundation of how medical care is financed in the United States.

In the 1960s Medicare and Medicaid were created: federal and state programs to provide healthcare to the elderly, Medicare, and to the poor, Medicaid. Because of rising cost of healthcare in the 1980s it was thought that medicine, the cost of medicine, should be left to the marketplace. That will decrease the cost. Managed care was introduced; HMOs were introduced, and it soon became clear that this was a failed experiment because medicine just does not obey or respond to normal market forces.

And then the human genome was sequenced around the turn of the century, entering the 21st century. But, again, just as there was tremendous uncertainty and trouble at the turn of the 20th Century I submit that there is similar uncertainty and potential trouble as we move into the 21st century.

Now, what are some of the trends that I see as shaping the landscape for medicine over the next several years? Well, one is increased cost of healthcare. I don't see anything on the horizon that over the next, certainly over the next ten years is going to stem the near double-digit yearly increases in the cost of healthcare. And I'll have more to say about this, all these points in a minute.

There will be an increased focus on quality and outcomes, what I refer to as consumerism. That is, those who use healthcare will want to have more to say in terms of the affordability of their care, the accessibility of their care, and the quality of their care.

There are tremendous changes in the demographics which will change medicine. We are becoming a more diverse society. We are becoming an older society. By 2020 just under 20 percent of the society will be over the age of 65 and 25 percent of society in the nation is underrepresented minorities. That's closer to 50 percent in Texas. There's going to be tre-

mendous impact of increasing technology on medicine. The world of medicine is flat. Globalization is having tremendous impact on medicine, not only in the practice of medicine but in education and research.

And, finally, there's increased self-responsibility for health. Individuals are interested on finding out on their own about diseases, about treatments, et cetera, and using that information to treat their own issues.

What about this issue of cost? In 1970 the total cost of healthcare in the United States was roughly $73 billion, $348 per year per capita, 7 percent of the Gross Domestic Product. Fast forward to 2002: 1.5 trillion, over $5,000 per year per capita. This year it's closer to $6,000 and 14.8 percent of the GDP. And 2010 is predicted to be 2.7 trillion, 17 percent, and over $8,000 per capita per year. This has had dramatic effects on the cost of health insurance, the monthly premiums that employers and employees have, and it's led to a rising increase in the number of individuals who are uninsured. Because they lack health insurance their health status is poorer than those individuals who do have health insurance, and they can't access healthcare like those individuals who do have health insurance can access healthcare.

The number of uninsured in the United States now is roughly 46 million individuals. That number is equivalent to the number of individuals in the total United States that are covered by Medicare or Medicaid. We are the only developed country in the entire world that has this issue: a significant percentage of our population can't get the healthcare they need and deserve simply and solely because they lack health insurance.

If we pay this much, is the quality of healthcare in the United States better than it is elsewhere? And, sadly, the answer is no. If one looks at metrics like longevity, birth weight of individuals, et cetera, we don't rank in the top in categories, but we're somewhere in the middle. We are the most expensive in the world. Switzerland, which is the next highest country, has healthcare costs which are roughly 60 percent of what they are in the United States. Now, interestingly, although other countries like England, Canada, Switzerland, et cetera, have healthcare costs that are

U.S. Health Care Expenditures

	1970	1980	1990	2000	2001	2002	2010
Total	73	245.8	696	1.3	1.4	1.5	2.7
Per capita	$348	$1,067	$2,738	$4,672	$5,035	$5,427	$8,885
% of GDP	7%	8.8%	12%	13.3%	14.1%	14.8%	17.1%

Source: Centers for Medicare & Medicaid Services

less than the United States, the rate of increase in those countries is now very similar to the rate of increase in the United States. So although the healthcare costs start out lower they are seeing double-digits rates—yearly rates of increase similar to those seen in the United States.

Demographics are going to have a very important influence on the practice and education of medicine. We are becoming a very diverse society, but the demographics in the medical profession don't mirror that. If we say 25 percent of the Americas are underrepresented minorities, only 6 percent of physicians in this country are underrepresented minorities. I submit that we cannot conduct medical research, we cannot educate in medicine and we cannot provide medical care to a diverse population unless we have a medical workforce that reflects the diversity in that population we are committed to serve.

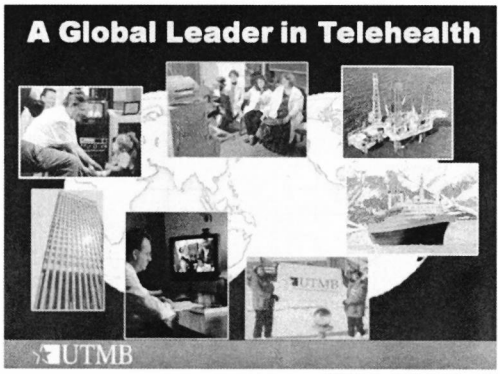
There's another interesting phenomenon that's going on, and that is individuals in the medical workforce are changing in terms of their demographics. It used to be that physicians predominated in the medical workforce, and that is quickly changing. There's been a 37 percent increase in physicians over the last ten years, but a 200 percent increase in physician assistants and nurse practitioners. So the ratio of non-M.D. health professionals to M.D. health professionals is rapidly increasing. And this is going to have an important effect on how medicine is practiced, and I submit could have a beneficial effect on the practice of medicine.

There has been only one new medical school in the United States established since the mid-1980s. And in the same time there have been many more new programs in nursing, allied health sciences, and physician assistants established. While there's only been one new medical school in the United States established since the eighties, there have been 15 new medical schools established in countries that are offshore in the United States educating physicians outside the United States.

So it's becoming clear that physicians are no longer the epicenter of the medical workforce. And this will have an important effect on how medicine is taught and how it's practiced. More and more it's becoming clear in this increasing sea of non-M.D. health professionals that there needs to be a team approach to the practice of medicine. The Institute of Medicine, in a report in 2003, stated the following: "All health professionals should be educated to deliver patient-centered care as members of an interdisciplinary team emphasizing evidence-based practice, quality improvements approaches in informatics."

And this is an approach that we have taken here at UTMB because we do have four health-related professional schools and it is occurring elsewhere—that is, it takes students in medical school, nursing school, allied health professional school and have them educate together so they can learn early on how to practice as part of a team.

The technology is also going to have a very important impact. At noon you're going to hear from Glenn Hammack about the concept of E-Health and telemedicine. Since 1994 UTMB has been developing this concept of



Increased Self-Responsibility

% Internet Users Researching Health Topics Online

2001	62%
2005	80%

Top 3 Online Activities

E-mail	93%
Researching product/service before purchase	83%
Looking for health/medical information	80%

telemedicine—that is, using telecommunications to produce healthcare at a distance. We have developed a very sophisticated system now so that we can do everything at great distances that you can do sitting face to face with a patient except touch the patient. You can examine the eyes, ears, nose, mouth, listen to their heart. You can use various types of scopes to look at various orifices, et cetera. But you can do just about everything you can do sitting face to face with a patient except touch the patient. Indeed, we deliver healthcare in the criminal justice system to incarcerated individuals hundreds of miles from UTMB using telemedicine, to businesses located several miles from UTMB, to a clinic in Nacogdoches for children with special needs, to imaging care clinics in two contiguous counties, to drilling platforms in the Gulf of Mexico, to cruise ships as they cruise in various parts of the world. And we are responsibility for the delivery and healthcare to 3,500 scientists on the South Pole, and we do it from this building.

So this is just one example—and there are many others—of the impact technology will have on the delivery of healthcare.

As I said, the world of healthcare is flat, borrowing Friedman's terminology, and there are several examples of that. Many institutions now provide magnetic resonance imaging and computerized tomography scans and x-rays during the day. They digitally transmit those to India at night, where it's daytime in India. They're read by individuals in India. The reports are sent back in the middle of the night to the United States. And in the morning the physicians or whoever else has access to those x-rays. So I'm indicating the flatness of the world in terms of medicine and the impact of technology. One-third of the graduates of residency training programs—a residency training is training that occurs after medical schools for individuals in various specialties—one-third of those graduates now come from non-U.S. medical schools. As I indicated, while there's been one new medical school established in the United States over the last 20 years there have been 15 new medical schools established offshore, and India sees a great opportunity in increasing its ability to educate physicians.

The global spread of emerging infectious disease, beginning with AIDS

then SARS. In five years West Nile moved from the Middle East to England and then spread across our 48 contiguous states in the United States. Perhaps the most dramatic example is SARS: six months, 30 countries showing how fast these infectious diseases, which are normally constrained to one small area of the world, can quickly become worldwide scourges requiring that we in the United States think of medicine not just in the United States but, indeed, globally.

They mention that there is increased personal responsibility for medicine. And going online to look up symptoms, diseases, treatments, diagnoses, et cetera, is just one example. In 2001 62 percent of individuals using the internet were looking at health-related topics. In 2005 it's 80 percent. If you look at the top three online activities the highest is e-mail. The second is research in products and services before purchase. But the third is looking for health and medical information. More and more people are coming with information that they read about or get online about their issues. This has led to a term called cybercondriacs, where individuals go online and then think they have the symptoms that they read about.

So these are just some examples of the things that I think will shape medicine in the future.

Now, are there things we know for sure? Well, I think there are. I think that there are some things we know will increase. One is the cost of healthcare. As I said, there's nothing that I can see over the next five or ten years that is going to have a dramatic effect in decreasing the rising cost of healthcare. This will lead to an increase in number of uninsured and an increase in what's referred to as health disparities. These are disparities in health, particularly access to healthcare, that is simply related to differences in gender, differences in geography, differences in ethnicity—and also results in differences in health outcomes that is simply related to such differences and differences which don't have anything to do with the state of health, but have to do mainly with the economics and the impact the economics has on the access to healthcare.

We definitely will see an increase in the role of non-physicians in the provision of healthcare, physician assistants, nurse practitioners, and others, people from public health backgrounds, et cetera. There definitely will be an increase in the quality and safety of healthcare.

There clearly is going to be an increase in complex ethical issues. Stem cell is just one obvious example, there are many others. There's going to be an increase in the portability of the health record, that is, your ability to take your health record from one provider or one entity to another and have it transmitted to follow you as you traverse the medical system. There's going to be an increased emphasis on chronic diseases because chronic diseases create the bulk of disorders that impact on the cost of healthcare.

There's going to be an increase in population-based medicine. What I mean by that is how can you take a finite amount of health dollars and do the most good for the largest number of individuals as opposed to using

it to treat only an individual when that treatment may not be most appropriate. And there's going to be an increased focus on wellness, not simply disease intervention, but how can you maintain health and working with individuals in a responsible fashion to maintain their wellness.

There are also some things I think we know will decline. Universal access, well, there isn't universal access now, but access to healthcare will continue to decline as the number of uninsured continue to rise because the cost of healthcare continues to rise.

There will be a decline in practice variations in medical areas. Practice variations are variations in the practice of medicine which have nothing to do with quality and outcomes, but simply have to do with things like differences in geographic location or differences in the way individuals providing that healthcare were trained. For example, treating an individual aged 65 years in Sun City, Arizona, is about one-third the cost of treating that same individual in Miami for the same disease with no differences in the quality of treatment and no differences in the outcome. That is a practice variation. Or you can go into two cities that are 50 miles apart and find tonsillectomy rates that are three times different in those two cities and not occasioned by any difference in the quality or the outcomes, but simply are related to differences in geography and differences in training.

There's going to be a decrease in the ratio of U.S. physicians to non-physicians as more non-physician health professionals are educated, unless there's a dramatic change in the number of U.S. physicians that are educated. And I think with this we're going to see an influx of more individuals who are trained outside the United States.

There's going to be less government support for medicine. This includes research, education, and clinical service—simply occasioned by financial constraints. And, sadly, there's going to be a decline in the influence of the medical profession on the environment and within which they're working. I think the medical profession—and I'm referring to any health professionals—have lost credibility over the last several years because of things like quality issues, errors in medicine, practice variations, rising cost of medicine, blatant issues of fraud and abuse, etc. Also Failure to implement rapid changes and things like portability of the health record so that others are stepping into that void and making those changes. So I think unless something changes there will be less of an influence of the medical profession on the environment in which they work.

There are some wildcards that could dramatically change medicine in this country. One is the political will for universal access. Right now there is very little political will for universal access, mainly because there's very little economic wherewithal to do it. If that changes because of some calamity or because of some change in the political landscape that could have a dramatic change in medicine, much like the same change that the implementation of Medicare and Medicaid had on medicine in the 1960s.

Another wildcard is changes in the medical workforce and the way medicine is practiced. I think that we have a great opportunity to look

at how medicine is practiced here in the United States, to use more non-M.D. health professionals, and I submit to do it in such a way to decrease the cost of medicine while at the same time increasing access and quality.

A bioterrorist emergent infection calamity could have a dramatic effect on medicine, much as the way polio, SARS, et cetera, the potential for avian flu, which we'll hear more about this afternoon, could have and has had.

The influence of payers, those who pay for healthcare, either through insurance or other programs—whether that be the federal government, state governments, employers, or whatever—the influence they are willing to have on the choice individuals have in terms of where they receive their healthcare, the quality of that care, et cetera, could have a tremendous impact on medicine.

And, finally, the extent to which medicine embraces globalization. Globalization medicine is rapidly occurring, and if American medicine doesn't understand that, embrace it, and become part of it, it could have a dramatic effect on medicine. And, conversely, if it does it also could a dramatic effect on medicine. We have a single worldwide curriculum for educating physicians. It's no different in England than it is in Germany than it is in the United States. We could have single worldwide licensure requirements for health professionals. We could do a lot if we embrace the global community and a lot for the health of the world.

So, in my view, medicine over the next short term is going to be for the haves and the have nots. What I mean by the haves is for those who can afford to access medicine, medicine will be of the highest quality, it will be safe, it will be outcomes based, it will be led by a team of health professionals—maybe not led by a physician-- and healthcare will be received not in the traditional settings like a clinic or a hospital, but in some other settings.

For those who can't afford medicine access then healthcare is going to be episodic, it's going to be uncoordinated, it's going to occur in traditional settings like the emergency room or traditional hospital, and it's going to be aimed not as wellness or prevention, but going to be aimed at disease intervention.

The real wildcard, in my view, is will the United States maintain its dominance in health? As I said, just 100 years ago the epicenter for medicine in this world was not the United States, but it was France and Germany. Is the next epicenter for healthcare going to be India or China? And that, to me, is a possibility for this century.

But if the health professional, much as it did at the turn of this century,

reaffirms its contract with society to provide the most accessible, most affordable, highest quality, most advanced medicine for all then I submit the United States will maintain its dominance. Thank you very much.

Discussion:

DR. ROMO: Good morning, Dr. Stobo. And let me commend you on your great work that's being done. I'm Ricardo Romo, president of the University of Texas San Antonio. And I had a chance to hear a fabulous presentation by Dr. Stobo on Katrina and of preparation that was phenomenal. I wonder if you could just share a few things on us on how this institution was a model for how to prepare for pending disaster.

DR. STOBO: Ricardo is referring to what we had to do in response to Hurricane Rita, and let me back up a little bit. In August of this year, at the request of the Governor, who asked a lot of institutions, particularly health-related institutions on the coast, to evaluate their hurricane preparedness plans. We will have to re-evaluate ours. We have six hospitals on this campus. For the past 114 years when there's been a hurricane, we have not evacuated the hospitals. We have discharged our most well patients, kept our sickest patients in the hospital, and hunkered down, so to speak, to provide care to those patients with about 1,000 to 2,000 employees.

In August we started to rethink that, whether we should evacuate the hospital, and then Katrina came. And it became clear that we need to seriously think about evacuating a hospital in the face of a Category 4 or Category 5 storm. So we said in August, well, we have six months to do this. So let's put together a plan that we can look at in February. And, of course, then Rita came and we had just about started on the plan, so we didn't have a plan.

And that Sunday when it looked like Rita was coming into the Gulf we started to put our team together. On Monday and Tuesday, when it became clear that it was going to be a very dangerous storm and was going to be headed for the Texas coast, we started to make plans to discharge our non-essential employees and our students, those individuals who aren't required to maintain and provide services on the campus. And then when it looked like it was even going to be more dangerous on Tuesday night we decide to, indeed, evacuate the patients in our hospital. We had roughly 440 patients in the hospital, many of whom were extremely sick because the wellest patients had gone home. And these are individuals on respirators, babies in incubators, the elderly, et cetera.

So with the help of the state and the county and the city we began Wednesday morning at eight o'clock in the morning with access to 90 ambulances, 40 helicopters, and five fixed-wing airplanes to evacuate our patients. That at eight o'clock on Wednesday we had one patient left in the hospital.

We had never done this before in 114 years, so we didn't have a plan. But it just points out what people can do when they roll up their sleeves and come together under great leadership, Karen Sexton, who was our incident commander , come together to do special things for a very special population—the patients we're committed to serve.

Then the next day we let all the employees—we had about 1,000 employees—who wanted to leave to do so, with the exception of the ones that we had to maintain here to keep services open. We kept our emergency room open all through the storm. And we evacuated, using two C-130s, about 250 employees to a shelter in Fort Worth. So Thursday night it was pretty lonely. We had about 400 employees, and Friday we just battened down and waited for the storm. Fortunately, it was much less severe than we predicted. But it was a pretty stressful and busy six days. But we were pleased that we were able to remove our patients and the majority of our employees from harm's way and pleased that we didn't have as much damage as was originally projected.

And, to me, it's a great example of what I refer to as a productive community, that is, a group of individuals who come together, and, irrespective of titles, positions, or where they are in institutions, understand that everybody can make a difference and work together as a team to do something pretty extraordinary. Thanks, Ricardo.

AUDIENCE: Good morning, Dr. Stobo. In 2003 when Congress passed a prescription drug benefit plan under Medicare one of the things that Congress also did was to create health savings accounts. And you mentioned as part of the future growth and consumerism on the part of patients making choices, both as to the price and utilization in terms of their healthcare. Obviously, the incentives are different than if all you have to pay is a $10 co-pay and the insurance company, some faceless, nameless organization, is paying for perhaps duplicative tests or maybe even unnecessary diagnostic tests.

So what I wanted to ask what you foresee for the future when it comes to the transparency of pricing of medical care. I know in California and elsewhere there have been some experiments with requiring hospitals to publish the list of their most commonly provided medical services. And I think people have noticed. I mean, there's been a wide disparity, an interesting disparity. But it gives consumers more information with which to make a choice based on outcomes and pricing and that sort of thing. And what impact do you think that will have on the rise of increased costs of medical care, the growth in the costs you predicted?

DR. STOBO: Well, sir, I think that that could have a beneficial effect on the cost of healthcare, and I think we will see that. We've talked about that here. For example, if you come into our clinic for a test you don't know how much that test costs until you get the bill.

And the start of employee-based insurance in the 1940s was a good

thing, but the downside of that is you're not responsible for the cost outside of a co-payment. Somebody else is paying for it, so we collectively as a society have not been attentive to the cost and have not made decisions on the basis of cost in the past.

But, I think the financial pressures are going to force that issue and make that happen. I think it's going to happen at a state level. The states cannot afford to continue to support Medicaid to the level that they have supported. And pharmaceutical costs are a big part of Medicaid expenditures, not the most and not the biggest, but perhaps the most rapidly increasing. So I think we'll see a lot more transparency in pricing of pharmaceuticals, services, tests, et cetera, and also in providers. And that's where the influence of payers could come in.

If a large employer says to its employees: "Look, you go to Provider A because we have followed outcomes, we have followed indicators of quality, and we know cost. And putting those things together ensures a value added. We think Provider A is where you go. Provider B is almost as good, but not as good. So if you go to Provider A the co-payment is $20. If you go to Provider B the co-payment is $50. If you go to Provider C the co-payment is $100." And use that type of leverage to direct its employees to a specific provider.

Now, they have been unwilling to do that in the past for a couple of reasons, labor unions are resistant to that and also for liability issues. You force me to go to Provider A, I had a bad outcome, and that's because you made me go to that individual. But I think we will see that more and more. And it's going to be a cost issue and affordability issue. Look what's happening in General Motors, for example, Delta Airlines. You can right on down the list. And talk about globalization? We're losing our global competitive edge because of the cost of healthcare and the impact that has on the cost of what we produce.

AUDIENCE: A few years ago there was a story about a physician coming down and giving a lecture. And he prepared his lecture and prepared slides and giving his anecdotes of special patients and so forth and put this all together after a long time, went down to one of the medical schools. He came down and went to a beautiful room like this with 120 students supposed to be in there. He was surprised because there were only six students sitting in the front row. And he thought, "Gosh, somebody must have spent a lot of money telling everybody that I was a lousy doctor and not to come listen to me."

Turns out that this was the policy. The students paid the other six students to record the lecture. And all they had to do was memorize the thing and they never had to come to class until the final exam. If they passed the final exam they went on. Is that still the policy?

DR. STOBO: That was common. Let me tell you a little anecdote. There was a story where a guest lecturer came into a classroom and looked into

an auditorium like this and there were five students. And one of the students came up and put a tape recorder on the podium and he began his lecture. And what was happening was the student would then take that, transcribe the notes, and sell them to the rest of the students. So the next day he came in, turned on a recorder, and left the classroom, and it just gave his lecture.

I think medical schools throughout the country are looking at better ways of educating students, particularly in terms of this concept of lifelong learning, educating them so that they can out and continue to educate themselves. Because what you learn in four years of medical school rapidly becomes outdated. And so you need to learn how to keep up with all the information, the reams of information that comes along.

One approach that was started in Canada and came to the United States in Case Western and one that we have actually taken up here and at other schools is to go to small group sessions. So we have for just under half of our lectures, small groups where there are eight to ten students who work together in a problem-based approach. They're given a problem by the instructors and mentors not given a lecture and not lectured to. Then the students go out on their own working together to try to solve their problem.

Rather than teaching anatomy or histology or, biochemistry in a didactic fashion you present those students with a problem that includes anatomy, histology, and biochemistry. But they go out and, with some direction, learn that on their own. Now, we think that is going to be better in terms of this concept of lifelong learning and gets away from the large amphitheater type of lectures. More and more medical schools are experimenting with approaches like that to obviate or get around the very thing that you mentioned, which is pretty static and objective and not very dynamic.

AUDIENCE: How long does that last?

DR. STOBO: Well, it goes through all four years of medical school. There's a question up here.

DR. NICHOLAS: I appreciate your very good analysis of our healthcare situation. You paint a fairly gloomy picture that we've inevitably going to have a decreased access and an increased healthcare cost.

You're well aware of the studies that have been done in several states that show that they're not totally unrelated. Particularly, you've said they've been done twice in California. The recent study in California showed if you initiated total healthcare for everyone in the state of California you would significantly decrease the total amount of money spent in California. The plan being considered, according to the Lowen study, shows that actually they would spend $8 billion less in healthcare costs by including everybody under healthcare. My question is, is Texas looking to get any kind of study like that?

DR. STOBO: A group of experts from Texas Tech, A&M, and UT were put together to research the issues of access and cost, and particularly the issue of uninsured individuals who don't have or have far less access. We've spent the last year-and-a-half analyzing the issues and proposing solutions. And one of the solutions I think that we're pretty unanimous on is there should be more experiments done, more demonstration projects. They'll look at different ways of addressing issues related to quality, cost, and access. And then out of that hopefully you could develop best practices.

So the short answer is, yes, in Texas we are doing some of that. Barbara Brier, who's here, has been working with what's called a three-share program, which addresses the health needs of the working uninsured where the employer pays a third of the premium, the employee pays a third of the premium, and then we use other state or federal funds to cover the remaining one third of the program. This has been started out in Wisconsin, is in a couple of other cities in the country too. And in those cities where that program has been initiated it does increase access, increase quality, and actually decreased cost. So we do need more experimentation.

DR. NICHOLAS: Doctor, just one question about this employer-based reimbursement system in the United States. Is there any other developed country in the world that has the employers bearing as much proportionate of the healthcare cost as the United States?

DR. STOBO: To my knowledge the answer is no.

AUDIENCE: South Africa is the only other country that does it.

DR. NICHOLAS: And South Africa has found a way to cover its uninsured recently.

AUDIENCE: Yes.

DR. STOBO: So the answer is South Africa has one. But are they as predominant?

AUDIENCE: No. With the change in government there they're moving more to a federal system. They're the only country.

DR. NICHOLAS: Has anybody looked at the cost, the globalization cost that is, the lost business opportunities of American business trying to compete with countries that have a different funding system?

DR. STOBO: Well, all I know is there have been anecdotal stories. You know, for a $10,000 car, for example, $1,200 of the expense of that car is related to the healthcare cost. But you can see what's happening to various companies that have to go into bankruptcy because it cannot afford

the obligation to provide the healthcare costs to its retirees. So, although I don't know of any formalized study, I'd say it has a pretty dramatic impact on the global competition and will have more of an impact as global competition increases.

MR. WRIGHT: Lawrence Wright from Austin. I understand that this school has just opened up some sort of partnership in Austin which is the largest metropolitan area in the country without a teaching hospital. What kind of entity is it going to be? Is it going to be a medical school or what do you foresee in your extension into Austin?

DR. STOBO: Well, the question relates to our activities in Austin. We actually have been involved in educating students and residents in Austin since the early 1960s. And, because that has felt so good to us and worked so well for us and provides a high quality education, we in the late 1990s started to increase activities there by increasing the number of students and now the number of residents that we're responsible for, but receive their training in the Seton Hospital system particularly Brackenridge in Austin.

We also have been very fortunate to increase our partnerships and programs with the University of Texas in Austin in terms of research partnerships. And we also have a combined what's called M.D./Ph.D. program with UT Austin, where individuals can get an M.D. degree and a Ph.D. degree, not at the same time. It takes a little longer, but it's a combined program. Our idea is to continue to look at these relationships on a programmatic by programmatic basis, and where it makes sense to build on them, continue them, and enhance them.

We are not coming lightly into this thing; we want a medical school in Austin in five years. First of all, medical schools are extremely expensive the way they're constructed right now. This is politically a very hot topic. And there are probably other places in Texas that need to have a medical school before Austin. But that's not our goal. We are very good at developing partnerships, probably because we're on a barrier island. Having a partnership with Austin to enhance our educational goals in a mutually desirable and satisfactory fashion just makes sense to us and is something we're going to continue.

Let me say, we would not have been able to evacuate our patients if it weren't for the relationship we have with Seton. Seton took 170 of our 225 patients that had to be evacuated by ambulance or air. And we did not have that relationship preceding our Rita we would not have been able to do that.

MRS. KECK: Patricia Keck from Laredo, Texas. You showed us a time line from the 1900s to the present. If you were looking at that time line inthe 1900s I would say your medical school classes were primarily young men, whereas now there's a wonderful gender balance. How do you see that the change in gender balances affects medical education and medical practice?

DR. STOBO: Well, that's a very good question, I'm glad you reminded me. The point that's being made is, if you go back to the 1900s there were very few women. There were very few women in medicine in the 1960s. In my medical school we had forty students and only three that were women. Now, the majority—fifty-one percent of individuals in medical school are women. That is going to have a dramatic impact on practice. In my view I think a beneficial impact. But I think that we can see in general, in part occasioned by the increase in number of women going in practice, a greater interest on lifestyles in practice than on how much money can you earn, et cetera.

And so I think that is one of the impacts that we will see continue to happen as the proportion of women in medicine increases. If it weren't for women going into medicine the number of medical students in this country would decrease dramatically over the last several years. And some specialties, obstetrics and gynecology, ninety percent of the individuals in residency training in that specialty are women. So women are having a profound and important effect on the medical educational landscape and will have a profound effect on the practice of medicine.

The dean of our school of medicine is a woman. I think there are probably half a dozen women deans out of the 125 medical schools that exist in this country.

SENATOR KRUEGER: Bob Krueger, New Braunfels. Thank you for a superb presentation. I'd just like to ask, as you see the proportion of healthcare provided by physicians declining in comparison with physician's assistants and other kinds of medical developments, how do you see the relationship of these medical providers to physicians changing? Will physicians continue to be the king on the heap or will others be allowed to make decisions for themselves and so forth?

DR. STOBO: Well, my own view, and it's not necessarily a popular view with my colleagues because I am a physician, is that the world of physicians, say, in 2020 will be much different and the role of physicians will be much different than it is now. I think they will be geographically localized to very special areas. They will be involved in very special parts of medical treatment. For example, they will be involved mainly, or they'll play an important role in medical research.

But I think the role of physicians will change. So they will not necessarily be the leader of a team or the epicenter of how healthcare is delivered. But they will be involved in very specialized diagnostic procedures and very specialized therapeutic procedures. And other health professionals will play a role, say, in other parts of the delivery system. Now, I happen to think that that can be done in such a way that really advances the quality of medical care and decreases the cost.

MR. WHITTENBURG: George Whittenburg from Amarillo. I would like to revisit an issue that Senator Cornyn has addressed. Seems to me to be a

fundamental problem in the whole cost of medical care that there's no point of sale accountability. Let me use an analogy. We've all heard the story about the people who go to lunch. And I'm going to say the doctor says, "Well, here, let me pick up the tab because I'm in a such-and-such tax bracket and I can deduct such-and-such." But the insurance executive says, "Well, no, let me pick it up because I provide healthcare insurance and I'm on a cost-plus."

The insurance companies are the ones who pay the bills. The patient goes in and can't even find out what it costs. And even if he can find out, he or she cannot find out what it's going to cost someone without insurance you can't find out because there are insurance contracts. And if you ask your doctor what is something going to cost the doctor doesn't have any idea. He's going to have to turn it over to somebody else. And it seems to me that divorcing the decision making or the accountability from payment in the decision to get a particular procedure is something that is a fundamental flaw in our system.

DR. STOBO: Well, I agree with you and I think that's what Senator Cornyn was saying. And I go back, it stems from the concept of employee-based insurance. Because the individual who receives the healthcare pays very little of the total healthcare bill and the payment is so small, there was no incentive for you and I as patients, for example, to understand the cost. Somebody else was paying for it. And there was very little incentive on providers because decisions weren't made on cost to provide the cost of services they were providing.

MR. WHITTENBURG: But even those conscientious employees who know that it ultimately costs the employer and takes dollars out of the system and may reduce what an employee makes who wants to find out and make rational decision, not just with respect to the co-pay

DR. STOBO: Right.

MR. WHITTENBURG: But with respect to the total cost and what can be done, there's no way to find out?

DR. STOBO: Well, again, that's what Senator Cornyn was getting at. That is increasing. I mean, you can go into a thick book now and look at UTMB and find out what UTMB does in terms of certain quality indicators. Does it give aspirin for individuals who come in with myocardial infarctions? And you can also get the cost of certain procedures. So gradually that information is being made available. There's going to be more and more emphasis in the future on making that information available and more and more people are going to be making choices based on that information.

Right now that's not the case. In a couple of studies, one in New York and the other in Pennsylvania, when the outcomes of procedures were made available to the public in terms of mortality or morbidity, choices of

the public were not made based on those parameters. They were not paid attention to. Now, the interesting thing is who did pay attention to it was hospitals. And hospitals instituted changes in those procedures to decrease the mortality and morbidity outcomes in certain procedures. And, again, it was a competitive issue. But consumers didn't make choices based on that. But I think that's going to change in the future.

DR. CAPPER: I'm Dr. Robert Capper from Fort Worth. There are certain aspects of the escalating cost of healthcare that you didn't touch on in this wonderful presentation. We're looking at a population in the United States where sixteen percent of our children are obese. The incidence of diabetes is increasing twenty-five percent over the last decade. All of these patient-induced conditions lead to escalating need for and cost of healthcare, in addition to obvious increasing cost of technology. Are we addressing that in our system other than occasional headlines in the paper?

DR. STOBO: Well, not adequately. But I think that we will start to address them more. I think more and more individuals or entities or payers of healthcare, including the federal government, are trying to develop incentives for individuals to take more responsibility of their own health in a beneficial way, patients with diabetes, for example, patients with obesity. And I think we'll see more of that as it is realized the enormous cost that those two conditions add to healthcare. And in terms of globalization, you know, obesity is not an epidemic that's present in just the United States. It is a global epidemic.

AUDIENCE: Doctor, I was interested in one of the comments that you made because it applies equally to a lot of professions, especially as in my profession of law where the demographics of the profession do not nearly equate the demographics of the population. And you alluded to that in the medical field as well. Do you have any ideas, any ways that we can increase the demographics of the professions to more equally equate the demographics of the state?

DR. STOBO: Well, first of all, let me just reiterate, your observation is absolutely correct. As I said, about six percent of practicing physicians are underrepresented minorities. About ten percent of physicians in training are underrepresented minorities. And that's been constant since the mid-1990s. Despite the fact that organizations like the Association of American Medical Colleges and others have tried to make a change in that, it has been painfully slow.

And it's not because there are fewer baccalaureate-trained underrepresented minorities in the pipeline. In fact, the number of baccalaureately trained underrepresented minorities has increased, but the number, the percentage, going into medicine has decreased. So medicine is losing its market share of a diverse and capable workforce.

This preceded my coming to UTMB, but they worked very hard at

UTMB, not by saying we need to get our numbers up, but by saying that we attract a special student here at UTMB. Students who come from disadvantaged backgrounds, whether economically disadvantaged or educationally disadvantaged, and want to go into medicine for passion reason, they do it with a passion, with the idea of going back into the communities and either through research, education, or clinical service give back to the communities.

Many of those are underrepresented minorities. And so we have had programs where we have mentoring programs, counseling programs. Individuals will come up spend a summer with us or, in some cases, a year. Some are taking special courses so that they can increase their educational level to be more competitive with their counterparts. And thirty-four percent of our medical students are underrepresented minorities. We were the number one medical school in the continental United States a year ago in terms of Hispanic medical student graduates.

So the answer is, yes, there are things that can be done. It takes a proactive approach to it, an approach that goes far beyond just a desire to get the numbers up. Because I can tell you that if you do it just by getting the numbers up, you will take a reasonable proportion of underrepresented minorities into the first-year medical school, but you'll lose them between year one and year four.

AUDIENCE: A problem that I think the system has to look at that is becoming more and more of a problem I've been in practice 47 years at this point. I graduated from this institution in 1951. When I first started out my malpractice insurance was $75 a year. Last year it went up to $39,000 a year. Now, I have never been sued. I've never been in court. I've never had a court situation, so that's no reason for it to go up. Some of the neurosurgeons have to pay $120,000 in malpractice insurance before they can even open up their offices. You're losing a lot of the older doctors because they say this is like General Motors, they can't afford to pay that high a price for malpractice insurance and stay in business. Unfortunately, this is a business. We have to pay our employees. I pay $1,600 a month for healthcare for my employees. And you're losing a lot of older people because they say we're just going to retire rather than continue with this.

DR. STOBO: Well, I agree with you. You haven't been sued because you've had good medical training obviously. But you're absolutely right. The high cost of medical malpractice is having an impact on the cost of medicine. But, more importantly, it's having an impact on the access to medical care. There are places in the state where obstetricians just won't practice because of the high cost of health insurance or neurosurgeons won't practice. And, therefore, you can't get those services in that part of the state.

Now, in terms of the overall healthcare cost it's not the number one driver or the number two driver, but it's up there among the top five in

terms of cost, depending on how you calculate it. Other than just the direct cost of the malpractice premium there are other things that health professionals will do because of their concern of over being sued or because of their liability things that they otherwise wouldn't do which are duplicative, shouldn't be done, added necessary cost to the healthcare, et cetera. So you're correct.

MR. LOCKRDIGE: My name is Lloyd Lockridge of Austin, Texas. And some years ago, only about three, I had what they call a heart flutter. And the doctor said that you can do this or you can do that. And one thing you can do is to have an ablation. Well, that was a wonderful thing. Some years prior to that I served with a man who's here I think, named Mark McLaughlin, and a man who's no longer here, named Mark Martin of Dallas, on a commission. There were about ten doctors. They had something called informed consent that the Legislature had adopted. And our commission was designed to address that and see what forms might be established. Half the doctors on the commission were mad as hell that there was this to go through. They didn't understand it and so forth. So we worked on that for two or three years. Now every time I or any member of my family goes to a hospital we get these informed consent things.

Now, relating that to some of what's been said, I happen to have Medicare. I'm very grateful for it, but I have no idea what anything costs. I never see a bill. It used to be that when a member of my family would be coming out of the hospital they'd ask how we were going to take care of this. When you see what Medicare does to the $25,000 overnight hospital bill for my ablation. The doctors and the healthcare providers start having to say to the patient, "Look, if you do this procedure it will cost somebody $25,000. If you take medicine the rest of your life it will be whatever the medicine costs." Where are we going with this? And does that have anything to do with this subject?

DR. STOBO: Well, the answer is yes. I'm going to ask Ron, do you want to say a few words? Ron's thought a lot about this in his role as director of our Institute of Medical Humanities and his interest in medical ethics.

DR. CARSON: Well, you mentioned informed consent. I mean, the purpose of informed consent is as the terms suggest, asking you as a patient for your permission to undertake a procedure. It's something that usually happens informally. Sometimes a piece of paper needs to be signed, but the piece of paper is really only worth the conversation that went on before informing the patient and asking for the patient's permission.

As far as costs are concerned, I think Dr. Stobo touched on that a little while ago. We're making progress in educating medical students, and particularly residents, about the cost of care. And patients are, if you look at that percentage of patients who use the internet looking things up, are

finding out what things cost and are going to become much more demanding, if you will, regarding the cost of care as well as the quality of care.

Thank you for your attention this morning. If we keep running over we'll run into lunchtime. The main thing I want to remember to tell you right now is that the game's going to be on the monitors out there as you head across the hallway for lunch.

E-MEDICINE

DR. STOBO: Glenn Hammack is our Assistant Vice President and Executive Director for Electronic Health Network. We gave him that responsibility, oh, about a year-and-a-half ago. It's responsibility for electronic health throughout UTMB. And he was charged with not only advancing electronic health in UTMB, but developing and bringing to UTMB the new modalities—the sons of daughters of telemedicine. So, Glenn, it's a pleasure to have you here.

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DR. GLENN G. HAMMACK[4]

Thank you very much for that kind introduction, Dr. Stobo. We wanted to take a little time today and share some of the programs and technologies that we use for electronic health or E-Health.

Now, E-Health has a lot of aspects to it. There's electronic health that refers to the phenomenal advances and devices to test your blood sugar at home. Or if you've been in airports or other public spaces lately, you may have seen things called AEDs, automatic defibrillators. These are the way electronics and technology are improving healthcare.

But one of the other ways that technology is having an impact is in the mechanism by which healthcare is delivered. You've got people exploring ways where people are e-mailing their doctor. You've got hospitals, insurance companies, healthcare organizations putting up portals where you can log in and find out your doctor's schedule and get information. You've got cybercondriacs, as were mentioned earlier, and electronic health records and telemedicine.

Telemedicine is an area that we have a special affinity here for at UTMB because of our background in it. Telemedicine is nothing new. One of the most notable first implementations of telemedicine was in Boston at Logan Airport. Not long after it was completed there was concern that being on an island there would not be a way to get healthcare to the airport if there was actually an incident or a problem. So a television system

[4] Glenn G. Hammack is Assistant Vice President and Executive Director of the newly formed University of Texas Medical Branch TMB Electronic Health Network.

was put in and this was really one of the first seminal implementations of telemedicine.

But telemedicine has not had the best of reputations all the time. It's been around for 15 to 20 years. There are valid criticisms as you go through the discussions about telemedicine. The equipment can be very expensive, originally over $150,000 per location. There's an impression that people don't like it, that the patients don't like it. I don't want to talk to a television set. I want to talk to my doctor.

From the medical establishment approach sometimes there were doubts—a doctor and a television set? How can this be real? And, of course, many policymakers have the concern that this is just going to be another way to bilk the system. They're going to set up shops in India and Bangalore, and you're going to be seeing doctors that you don't understand from thousands of miles away.

But we've had a bit of a different experience. And if you'll bear with me here for a moment we're going to share with you a recent T.V. spot from San Antonio [Playing of T.V. segment].

So a little different perspective on how far telemedicine has come. Now, how do we get here? UTMB has always had a special place in the state of Texas. Our slogan is Here for the Health of Texas.

If we take a look at this small graphic the blue-shaded counties are areas where there are unsponsored patients in high numbers. The green dots up there represent areas where there is outreach activity of UTMB across those counties. To cover those kinds of distances UTMB has had to develop technologies that allow this kind of work to be done.

The patient/doctor relationship is vitally important to all of us here at UTMB. One of the things we'll talk about at the end of this little discussion is returning to the digital house call. But the doctor/patient relationship today is based on the idea of bringing doctor and patient together. There are many in national healthcare policy making that are concerned that there's still a lot of energy in healthcare institutions about the next building to be built and parking deck to be designed and skywalks to be navigated.

Technology offers ways, opportunities, to bring doctors and patients together using technologies of telecommunications: satellite, fiberoptic, microwave. And at UTMB we've tried to respond to this challenge by building the technologies next to the patient and building the technologies next to the doctor that allow these telecommunications technologies to play a role in bringing doctor and patient together.

We have here at this end of the room an example of one of these devices, and I'd like to share with you a little bit about it here in just a moment. This is one of our T-carts or telemedicine carts. We operate about 250 of these in various locations across the state of Texas. About half of them are in prison facilities, but there are others in areas like Liberty County, Brazoria County, imaging healthcare programs, construction companies, and insurance companies around the state.

They provide everything that's needed to deliver this type of telemedicine care. It has an electronic medical records workstation. It has medical quality video conferencing. It has additional devices and peripherals that allow us to perform the examinations that you saw in the short video. The basic camera that comes with it is completely and remotely controllable by the doctor from wherever he might be on the network. And that includes zooming out and zooming in and providing a tremendous range of flexibility. The cameras are all automatic focus, automatic brightness control—I guess I should go ahead and focus in on my boss here—and they allow the doctor to provide the perspective into the examination room that he or she feels that they need to provide the examination.

Now, in addition to these types of cameras, we also include an electronic document camera. No matter how hard we try to make the documentation system and healthcare paperless paper always pops up. So we always put in one of these document cameras so that a last-minute EKG, lab results, other studies can be shared to the doctor, regardless of how far away they are, without anyone having to run to a fax machine or run to a scanner and do these types of things. This same device can be used to show x-rays. We have orthopedic specialists that can do this to do preoperative work, postoperative work, and, again, keep the patient where they are instead of having them to travel to see the specialist physician.

We always install one of these handheld medical scopes that is multifunctional. It has a fiber optic light in it. It has halogen illumination, so it's very bright for clinical work. And it has different attachments. This is an attachment for looking in ears and up noses. I'm pretty good with a Q-Tip. I won't leave this up long. And other examination scopes that can go all kinds of places you don't want to talk about at lunch.

In addition to this type of technology there are devices to send stethoscope sounds live from one place to another. And we build every one of these devices with probably their most important feature which is that anywhere they are in the world they can pick up a UT football game. So we're absolutely at a commercial here in the game, and in a few minutes here we'll put it on so people can catch up and maybe catch the kickoff.

Back to reality for a moment. What kind of environment do the doctors work in for this type of telemedicine environment? This is one of several telemedicine studios where we have physicians that do this work exclusively and tell the very bad joke that they don't have to wash their hands between patients. But it does very, very well. This is Dr. Oscar Boultinghouse, who I have the privilege of working with as our chief medical officer for the Electronic Health Network. He plays a very important role in identifying and training the physicians—primary care emergency medicine, cardiology, orthopedics—that work in these environments.

And up here on the screen is the vision into the clinical areas. That's a nurse working in a clinic with one of these carts. And then in front of him he has electronic medical records that allow him to get the information that he needs to examine the patient and understand the case. This is

another example of one of these rooms. This is Dr. Michael Davis, a cardiologist that practices exclusively. He crosses over between the correctional environment and the free world non-correctional environment.

About two-thirds of the telemedicine encounters we do are in the correctional environment. They represent a significant amount, but the growth in our non-correctional environment has been significant. We do over 60,000 patient visits a year solely by telemedicine. In the correctional prison care environment there is more specialist medicine delivered by telemedicine than by face-to-face encounters. And you may wonder what this like, so I have another short video (Playing of video).

I'm going to pause here for just a moment. What you're going to see now is one of the things that are very important in telemedicine is moving the information from where the physician's making a decision back to where the patient is so that it can be acted up. It might be prescriptions; it might be consultation reports. To do that and make sure it's done on a timely basis these providers exclusively use voice recognition systems, where as they speak it actually types their clinical notes. That's what's going to be demonstrated now (Playing of video). So you get a sense of what it looks like from the physician's end during one of these telemedicine encounters.

One of things that we're very proud of here at UTMB is the work that many of you are aware of for our role in biodefense. This afternoon you'll be learning more about that from Dr. Lemon. But we feel that the combination of the biodefense resources emerging here at UTMB, with our telemedicine capabilities, is an important combination. The resources again here are important and are unique in many cases to the United States. And using the electronic health technologies that we have to allow those resources to reach out, support folks in the field that are responding to a biodefense emergency, we feel is an important combination.

Telemedicine equipment does not have to look like the shiny white cart. You might not be able to spot the telemedicine equipment in this picture until we open it up and begin using it. We continue development in areas like this. And that has earned us some recognition on a national level from the National Homeland Defense Foundation. I'd like to show you a short video here [Playing of video]. So there you are. We're very proud of that recognition from the National Homeland Defense Foundation.

What we really look for in the future from this is a return to maybe a gentler day. One of the things that we think is important as we continue our journey in telemedicine and tele-health is a return to I guess the gentler time of the house call. And we are developing this skill set of connecting doctors to clinics. And we're beginning the journey of understanding the best way to connect doctors to the home.

All of these graphics on the screen are concepts, prototypes. But I guess in our world it is an opportunity to have technology play an important role in what we refer to as the lather, rinse, repeat of healthcare delivery, the importance of chronic care: get some labs, talk to the patient, adjust the medications, see you again in a while. But even specialty medicine is

referred to as having a lather, rinse, repeat. I'm going to see you to see what I need to see you for. I'm going to see you to do what we're going to do. And then I'm going to see you again to see if what we did worked.

Tele-health has an important role in many of those steps. And what we are doing now is developing the strategies in the partnerships so that when you purchase that glucometer for your blood sugar at Wal-Mart, when you purchase that scale at Bed, Bath, and Beyond, when you purchase that blood pressure cuff in your drugstore, that they innately have the ability to wake up in your home and identify you and identify your data to a secure system that shares that information to your doctors and to your hospitals.

I have an 80-year-old father who is a cardiobionic man in Detroit. And he still in the dead of a Detroit winter has to go out once a week and get his protein taken. And the idea that he has to do that, go out and risk a slip and fall in icy weather, is always a concern to myself and my family. The idea that this kind of information can be obtained in the home and that video technologies are available so that the physician visit is available on my dad's television set is really part of our future vision for the delivery of healthcare , for chronic healthcare monitoring and, again, really extending this reach.

Part of this reach is work that we're doing with partners across the state of Texas, with our UT System component colleagues in Tyler and in Brownsville. And we are doing this due to some important support through the Office of the Advancement of Telemedicine. And Senator Cornyn was very vital in putting this together and helping us get this important support. And I know all of us here at UTMB thank him for his role in enabling this to happen. This is going to allow us to investigate the role of telemedicine in three very different socioeconomic and demographic areas of Texas.

So, with that, I'm going to close with another short video. And then we'll go to the football game. And while I'm setting up the video I'll be happy to go back to the game. Anybody going to kill me if I go back?

Discussion:

DR. STOBO: I hope you can see how this technology impacts on a lot of things that were discussed this morning, certainly access to healthcare and quality of healthcare, the error issue regarding healthcare, and also the cost of healthcare. We can have various people on either end of the telemedicine linkage. We use nurse practitioners, physician assistant, corpsmen, as well as physicians. And so it does really impact on access, quality, cost, et cetera. Glenn, what does this cost?

DR. HAMMACK: We currently build and deploy these for just under $40,000, one-time cost. In some of our research programs and some of our smaller communities we actually lease them for under $8,500 a year.

AUDIENCE: What does it cost per patient?

DR. HAMMACK: Cost to a patient for a visit in most of our clinics where we bill Medicare or Medicaid or private insurance is really no different. We work very hard to coordinate with standard insurance programs. So to the patient there's no difference than they would have under their regular insurance. They may have a co-pay; they may not. It really works with their regular insurance programs.

DR. STOBO: We provide healthcare to the thousand employees of Amoco, which is located probably five blocks from here. And we did a study. If the employee at Amoco came up to UTMB to receive their healthcare the average time away from the desk where they worked was over 3.5 hours. The average time if they went to the telemedicine facility in the Amoco building was 30 minutes.

Now, Amoco thought that was so valuable for them that they pay the patient's co-pay if they go to the telemedicine facility in the building. But they go up to UTMB, the patient has to pay their own co-pay. It made financial sense to Amoco to have the patients seen in the building.

AUDIENCE: What's the training effort upon both the doctors and people on the other end?

DR. HAMMACK: That's a great question. The training is very straightforward. One of the things we had to do, again because this stuff started out in this very large prison healthcare program, we had 3,500 employees all across the state of Texas that had to be briefed and trained on how to do that. Literally every shift nurse, every physician's assistant had to know how to do this. In fact, we believe training is one of the things that were important to the successes that it had. We wanted that gadget over there to be as simple and easy to understand as a fax machine. And nobody should be scared of it and nobody is off limits to touch it. And if you don't know how to use it it's as big of a clinical sin as not knowing how to use your own EKG machine.

To do that we actually built a separate training team that we call the Clinical Technology School that is an ongoing group of about five or six individuals that run programs all around the state to take skilled, qualified, experienced healthcare practitioners and get them comfortable working in this technology. The other thing that we work very hard at is taking as much mystery out of it as we can. We really took an approach of, if you're walking on the floor of the hospital and the rubber hose pops off your stethoscope you don't throw it down and call for a technician. You understand what needs to happen and you push the rubber hose back on and you go back to work.

We tried to give all the folks involved a basic understanding of the technology so they could continue working. Physicians are trained. Dr.

Oscar Boultinghouse does put together a great program. It's kind of like training a pilot. You come and you get your basics and then you're watching somebody do it, and then you swap a place and you do it for a while under supervision, and then you go solo. But the average physician, it does change, varies quite a bit. We've had people jump in and learn it in as quickly as in one or two days. We've had folks take one or two weeks.

AUDIENCE: What's the status of performing surgery from remote locations?

DR. HAMMACK: Great question. There's tremendous interest and tremendous developments ongoing in the field of robotic surgery. UTMB and many other of our colleagues in the UT System have what's called the Da Vinci robot. It's one of the several types of surgical robots that are there. It is being done. It is still kind of experimental. It's having special value in the area of orthopedics where the robot can actually place implants and things like that with greater accuracy than the hand could. It also has tremendous use in microsurgery because it can actually reduce hand motion down to micro-millimeters but still retain the control.

Everybody's doing it. You know, are we going to get to a point where it's available everywhere and you actually go to your corner strip mall to get a surgery done? That's probably not going to happen in the near future. But developments are very impressive and it does have some very important applications in some of the areas that I mentioned.

AUDIENCE: Glenn, what is the situation with commercial users, with corporations? I know that Amoco was your original, and for a long time there was nothing else. And now Zachry's doing it. So what did they have to overcome to adopt it that was endemic to them rather than just the learning a new process?

DR. HAMMACK: That's a great question. We started out with this group called Amoco. We're now doing Zachry Construction. We're now actually completing some agreements with some other companies. It had a lot to do, at least I believe, with at one time there was a great resistance to have corporations have any kind of onsite medical care. There was fear of medical legal risk; you had people shutting down the idea of the company nurse. You had people shutting down the clinics on the plant.

Because they're all facing the challenges of rising healthcare cost to their employees while trying to retain benefits and preserve benefits to their employees, they're now starting to become much more open to alternatives. And that's why we're seeing development of additional contracts.

AUDIENCE: How have patients responded?

DR. HAMMACK: Patients overwhelmingly are in favor of it. And I'm not

just referring to the prisoners. I'm referring to folks in the counties, the folks that are in these commercial environments. We have been running patient satisfaction surveys for years, and it got to the point that they weren't telling us anything new. Everybody loved it.

To be honest, the perceptions of the healthcare establishment tend to be far more disbelieving in these technologies than the patients do. They're banking online and they're e-mailing pictures of their kids around the country. They get this.

AUDIENCE: How do you handle situations where blood work or other lab testing is required?

DR. HAMMACK: In our county and other types of programs there's actually a time reserved for that work to be done. The healthcare team that is there staffing one of these sessions is trained and credentialed to do the necessary laboratory work. They might be what are called a physicians' assistants. Of course, a nurses and paramedics are also trained to do this type of stuff. So it is built in to the strategy. It is built in to the strategy, that lab work. Also, where we have remote clinics far away, and we understand that these patients are going to need other types of things—imaging, MRIs, CT scans, things like that—we work very hard to identify resources local to the patient to get that work done.

AUDIENCE: And how do you maintain security and privacy and do you keep a permanent video of these things?

DR. HAMMACK: The security and privacy is always important. There is a general impression out there that if it's electronic it's more vulnerable. And there are some areas in which that's the case. Everything that we do is either done on a private connection that is ours alone between the two locations or it's done over areas where it might transit the internet, but it does so in a secure fashion called a VPN. We really borrowed heavily from the financial transaction industry, the big banking industry, about moving secure information from point to point to build that into the system so it operates at full compliance with HIPAA and the other regulations.

The other great question you have is about videotaping or recording. Just until recently just until last year Texas for Medicaid reimbursement of telemedicine required a permanent recording to be kept. It made it very complicated in light of the HIPAA regulations. They since have then changed that policy. So we do not now do any videotaping or recording of these sessions.

AUDIENCE: A short comment, but when you asked about the response I had to smile, because most of my patients in the last twelve years have been patients in their eighties in nursing homes. I don't think you want to survey them in how well they respond because they usually respond a lot to the personal touch—to someone holding their hand, someone they know, and

someone who's the old doc. So I think the older person in a nursing home would not be well served by this. I don't think it would work. They'd be better served by a person, a physician's assistant or a doctor.

Now, the other person who doesn't respond too well is the old doctor. This last week I made a diagnosis by touching a patient, moving his arm, and I wouldn't have done that if I had to see him on the television or the nurse doing the exam for me.

So I think it's a great technology; I think it has a wonderful use. But with great technology, there are always some limitations. And I have to laugh, because I'm in a business where there's a world of limitations.

DR. HAMMACK: We would agree with that. This is not the only modality to deliver healthcare, but in certain areas it can be a very useful adjunct.

AUDIENCE: People that might not get healthcare otherwise.

DR. HAMMACK: No, you're absolutely right.

DR. STOBO: Let me make a couple of comments because those are some great statements. First, do not get the impression that there's, you know, a dollar bill changer on the front of this and the patient just walks up and gets seen. These are always supported by a credentialed medical professional. It might be a paramedic, it might be a registered nurse, or it might be a physician's assistant.

The experience in the nursing homes, both with employees and with residents, has been very educational. Because there are aspects of what you mentioned earlier and there is an additional factor of transportation. The cost and the risks and the stress of moving an individual out of a supportive care environment and getting him into the hospital—things like that. So that's where it has had a role.

AUDIENCE: I can see that it would work very well for them.

DR. STOBO: That is the site of the national laboratory. The only national laboratory in the state of Texas is supposed to be one out of two national laboratories for research and emerging infection and biodefense in the nation. We're not sure what's going to happen with the national laboratory that's supposed to be built in Boston. It's running into some difficulty with its community.

It will be open in 2008. And we are real pleased to be able to have such a facility on our campus and in the state of Texas. The estimated economic impact for the state of Texas for this facility, without counting any downstream effect of start-up companies or products, is $1.4 billion. So it's a tremendous economic stimulator for the state. Thank you all very much for your attention. And, Glenn, thank you very much.

Emerging Infections and Biodefense

Dr. Stobo: In the late 1980s UTMB was very fortunate to recruit an individual from the University of North Carolina who had an interest in and was internationally recognized in the area of tropical medicine. Tropical medicine is actually the study of infectious diseases that are restricted to the tropics.

This individual came to UTMB with a dream of making UTMB the world's leader in the area of tropical medicine and emerging infectious diseases. And program by program, individual by individual, and facility by facility he and his colleagues have gradually developed that program until it is arguably among the world's best program in the area of emerging infections and tropical medicine.

With the events of September 11, we realized that we had a societal responsibility to use our facilities and our expertise to address issued related to biodefense and bioterrorism since many of the organisms that our scientists were working with were ones that could be weaponized and used as weapons in a bioterrorist attack.

Stan Lemon came to UTMB in 1997, also from the University of North Carolina, and shared the vision of making UTMB a world leader in emerging infections and infectious diseases. Stan is a nationally and internationally recognized scientist and microbiologist with a primary interest related to hepatitis, particularly hepatitis C, but is very eclectic in terms of his interests.

Stan was the dean of our medical school—the leader of our medical school for five years and then became the leader of a newly-created institute called the Institute for Human Immunity and Infections, which is sort of an umbrella for all our infectious disease activities, including biodefense activities on the campus. Shortly after 9/11—I think probably the day after 9/11—we created a center for biodefense to recognize the importance of the work here to that effort.

Stan has done a terrific job in pulling folks together and moving with his colleagues—moving programs forward. He has been on numerous panels at the state level and at that national level related to emerging infectious diseases. He has been asked by Senator Levitt—I mean, by Secretary Levitt to be one of a handful of individuals to work with the Secretary and to advise him in the case of an avian flu outbreak in the United States.

So it's a real pleasure to have Stan come up and lead this discussion. He'll introduce his colleagues for this topic of Emerging Infectious Diseases and Biodefense. Stan?

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DR. STANLEY M. LEMON [5], DR. SCOTT C. WEAVER [6], AND DR. JOHNNY PETERSON [7]

DR. LEMON: Thank you very much, Jack. It's a pleasure to be here this afternoon. I'm just happy that the game is not closer or there might be fewer of you. It's good to see Texas doing so well.

I'm going to be talking this afternoon with two of my good friends and colleagues here in the infectious disease faculty, Scott Weaver and John Peterson, about emerging infectious diseases. I think to some extent emerging infectious diseases is a bit like a football game. Right now the score is—maybe the humans are little bit ahead of the bugs. But it's not clear what the end game is going to be. And it's a continuing struggle.

What I want to present today is, my part first, an overview of why infectious disease are important, what we mean by "emerging infectious disease"—throw out a few specific examples of that—and then describe some of the activities that are taking place here at UTMB to address those issues. I plan to focus more specifically on the question of highly pathogenic avian (or H5N1) influenza that has been in the press so much lately, and to update you on the current situation in Asia, describe some of the challenges that this poses for public health officials worldwide, and then wrap up with a specific plan—a proposal that we are developing in collaboration with some of our partners here in Texas, for improved flu surveillance in Texas.

Now, my message today will be that the threat of infectious diseases is much more broader than what we usually conjure up when we think of "biodefense". When we think of biodefense we think of bioterrorism—for example, the anthrax attacks of 2001. Those were very important signal events that we need to pay a great deal of attention to because it's very clear that when something like that happens once, someone will try it again sometime in the future. On the other hand, I think that most of us who work in infectious diseases believe that Mother Nature is the mother of all terrorists, and that that's what we really need to be concerned about.

[5] STANLEY M. LEMON is the John Sealy Distinguished University Chair and Director of the Institute for Human Infections and Immunity at the University of Texas Medical Branch at Galveston.

[6] SCOTT C. WEAVER is the Leon Bromberg Professor for Excellence in Teaching professor in the Department of Pathology at the University of Texas Medical Branch at Galveston.

[7] JOHNNY W. PETERSON is the Samuel Baron Distinguished Professor in the Department of Microbiology and Immunology at the University of Texas Medical Branch at Galveston.

But in truth these two threats, bioterrorism and the natural emergence of a new infectious disease, go hand in hand. So that is what I will talk about first in this overview. Then I'll be followed by Scott Weaver who will discuss in greater detail a virus that has threatened Texas in the past and may in the future—a naturally emerging virus, but one that also has a bioterrorism side to it potentially. And then Johnny Peterson will talk about anthrax and what we're doing here at UTMB to look at better ways to treat persons who might become infected with this bacterium.

So by way of starting out, I think all of you are aware of the fact that infectious diseases seem to be much more important today than they were perhaps 30 years ago. In fact, back a few decades ago, the Surgeon General of the United States made a statement to the effect that infectious diseases were licked. We had penicillin, we had antibiotics, and infectious diseases were on the run.

Well, since then we have eradicated smallpox and we have really knocked down polio. But polio is threatening to come back. Equally important, many new infections have seemed to emerge out of nowhere—diseases we knew nothing about before, diseases like AIDS or hepatitis C, for example, or Monkeypox and West Nile Virus infections here in the United States, where they never occurred before.

At the same time the antibiotics that we use to treat bacterial infections are becoming less and less active against the common important pathogens that we see in our hospitals every day. The problem of antimicrobial resistance is becoming very serious indeed.

Now, the factors that drive the emergence of new infections—for example the appearance of West Nile or Monkeypox viruses in the United States—are multiple. The overarching factors are shown on this slide: the deforestation of rain forests; social factors leading to migration from rural regions to cities internationally, resulting in the rise of "mega-cities" of 20 million persons, many of whom have no access to clean water or any form of preventive health care; global air travel, with potentially rapid transport of persons and pathogens internationally; the creation of new environments that favor the breeding of insects, important disease vectors for many pathogens; and finally, viral and bacterial evolution.

Most of these factors reflect the huge growth in the number of humans populating this planet; how we now occupy virtually every corner of this planet and what we have done to the environment and as we have changed the environment that we lived in, how animals, insects, bacteria, and the viruses have responded, in many cases changing the way that we can come in contact with as we have done so.

Keep in mind that a bacteria or a virus requires only a few minutes or even seconds to replicate one generation to the next. A human takes 25 to 30 years in today's society. So viruses and bacteria have the ability to change their genetic makeup much more rapidly than we do. They can out-evolve us very easily. They can more readily adapt to new environments, new situations and new opportunities for their own survival.

And the outcome of all this is shown on this slide: a really large number

of infectious diseases, many of which you will recognize, like H5N1 influenza or hepatitis C or Lyme disease, that are all new infections that weren't in the textbook when I went to medical school, which wasn't all that long ago. But there's others here that you will recognize like yellow fever and dengue, cholera—old infections that have historically threatened humans, but that are now re-emerging in certain areas of the world, or in some cases invading new territory.

And then on top of this map we have anthrax, the bioterrorist event here in the United States. Now, that's only one example, only one example in the United States even, where bacteria have been used purposefully to cause illness or potentially death, used with intent to do serious harm.

In this integrative view, we can really consider bioterrorism, or the human dissemination of a pathogenic agent, as simply another factor driving infectious disease emergence. Like many of the others, it is a factor driven by variety of socioeconomic, political, demographic issues.

Now, a seminal report came out of the Institute of Medicine in the early 1990s point out the danger that emerging infectious diseases pose. This was co-authored by Josh Lederberg, a Nobel Laureate, and Bob Shope, who was a member of the faculty at UTMB up to his death just a little over a year ago. That report was followed by a more recent report, "The Microbial Threats to Human Health" Committee report, which summarized their findings by concluding that a "transcendent moment nears upon the world for a perfect microbial storm", sort of like Sebastian Junger's report of the perfect meteorological storm.

This storm is coming about due to a convergence of factors that include changes in our physical environment, changes in the society we live in, the political and economic forces that drive human behavior, changes in ecology, the evolution of microbes and viruses and their interface with humans, and a variety of genetic and biological factors that we don't understand completely today.

Now, the outcome of all this is the advent of an infection like SARS. A disease caused by a coronavirus. Prior to its appearance in 2003 the textbooks would all tell you that coronaviruses don't cause serious pulmonary disease in humans. Now we know they do. In this outbreak, which had its origin through some interaction between humans and animals that we don't still understand completely, this coronavirus infected about 8,000 people and caused about 800 deaths worldwide.

The single most striking feature of this outbreak was the speed with which it spread; from China to Hong Kong to Toronto and that speed was facilitated by commercial air traffic, and the fact that you can now move from any point on earth to any other point in less than 24 hours. A hundred years ago that same movement would have taken weeks, if not months. So that speed of movement, coupled with a much greater number of people now populating the planet, pose great challenges, and create new interfaces between people and animals, opening up opportunities for pathogens to jump from one species of animals to another (i.e., humans). I think Dr. Weaver may talk more about this.

So SARS is one example: it popped up, it was controlled, and now it's gone away. Is it going to come back? We really don't know. It's a continuing possibility, however. I've already alluded to Monkey pox in the U.S. This was imported from Africa to the United States in Gambian giant rats that were brought into the United States as pets—a rather surprising fact. In pet stores, these giant rats infected prairie dogs, which also were to be sold as pets. And several pet owners, including some children, became infected, in all about 72 cases.

The monkeypox agent is a virus that's distantly related to smallpox. It belongs to the same family of viruses, but it causes a much less serious infection in humans. And in this case there were no deaths, but still a great potential for serious disease.

West Nile I think you're all aware of. It's changed our behavior. We don't sit outside in the evening any more unless we're enclosed in a screened porch, hopefully, to avoid mosquitoes. This is a virus that was unknown in the United States prior to 1999 when it suddenly appeared in bird populations near JFK Airport. Then, very predictably, over a succession of years, it expanded from that point in the northeastern United States westward until at this point every state in the country has experienced the virus. Last year, this past year, has been a relatively mild year for West Nile compared to what it was a few years ago. But we've had a total of 2,744 cases as of this week in the U.S. In Texas, 158 cases and ten deaths. So this is a very real continuing problem.

Prion disease or "mad cow" disease—you're all probably aware of the recent identification of several infected cattle in the United States. The magnitude of that problem and what that means for the cattle industry and human safety is something that's extremely important, yet not yet clear. You're all aware of what's happened in the U.K. in the late '80s and '90s where the mad cow outbreak among cattle led to a number of human cases and deaths associated with the mad cow outbreak in the U.K.

It's very interesting if you look at all of these emerging infectious diseases, as Dr. Julie Gerberding, currently director of the Center for Disease Control and Prevention (a.k.a., the "CDC") in Atlanta, has pointed out here, almost all of them have their origins in the interface between animals and humans. That is, they are mostly all "zoonotic infections". And from a policy perspective, one of the places where we fall down repeatedly in the U.S., and in virtually every other country in the West, I think, is in properly integrating agricultural (animal) health and human health control measures at all levels or the government and, indeed, even in professional schools!

In the United States we have the U.S. Public Health Service (the CDC monitoring public health and the NIH managing research) concerned with maintaining human health. On the other hand, we have the USDA taking care of animals. They don't talk with each other or work together nearly as much as they should. I think they're doing a much better job of it now for reasons that Dr. Gerberding's put on the slide here, but there's still

room for a lot of improvement there I think. And, again, I think you'll hear more about this this afternoon.

There are also viruses that can't be transmitted to humans from animals, and that pose threats only to our herd animals. Foot and Mouth Disease Virus (FMDV) is the most worrisome of these. This is a virus that was present in Texas several generations ago, but it has not been seen in this state for over 60 years, I believe. It's not been found in the United States for that period of time. However, the U.K., which was previously free of this infection, sustained a large and rapidly expanding outbreak in 2001, as you can see here. This outbreak was recognized rapidly, but by the time it was recognized, infected sheep had been shipped all over the country because of the large scale movement of animals within the sheep industry.

Within a matter of weeks, almost 4 million animals were slaughtered in the U.K. in an effort to bring that outbreak under control. The economic consequences for the U.K. were really disastrous, not only to the industry most directly involved. Walks in the countryside were banned in an effort to limit spread of this highly contagious virus, and the tourism industry was strongly affected. In fact, a survey by a government ministry in 2002, looking at six mainly rural districts, found that about a third of all businesses had been affected. As you can see here, about a fifth of those businesses were "very severely" or "devastatingly" affected by the outbreak.

This outbreak was brought under control by the slaughter of animals, previously the tried and proven way to stop an outbreak of FMDV. Our policy here in the United States today is that if a case is identified, the affected herd is slaughtered. There's no magic drug, no vaccine that we can use in today's setting to effectively control an outbreak. Now, in fact, there are good FMDV vaccines, but the reason that vaccines aren't used to prevent the infection is one of economics. It's currently impossible to distinguish an infected from a vaccinated animal by testing of blood, and the import or export of FMDV-infected meat is forbidden by the laws of many countries. Thus, it is the lack of willingness of any country to import meat or cattle products from a country in which FMDV infection is suspected in cattle or sheep. This would be the case if you used the vaccine to control an outbreak today. However, modern science should be able to find a way around this, and more research on this is needed quite urgently.

And then, finally, bioterrorism, another facet of infectious disease emergence, due to purposeful, malevolent, human-mediated dissemination of pathogens. You'll be hearing more about this from Dr. Peterson.

So, as Dr. Stobo was saying at the outset, when the anthrax attack happened in 2001 we believed—we felt very strongly—that we here at UTMB could contribute in a significant way to the national response to the concerns raised by bioterrorism, which were great, as you know, in the wake of the 2001 9/11 events. Prior to that period of time we had, been developing a program that focused on natural mechanisms driving the emergence of infectious diseases. You'll hear more about this from

Scott Weaver shortly. The Center for Tropical Diseases was started here at UTMB under Dr. David Walker's direction in 1994, and had achieved the capability to work with viruses in ways in which interactions between insect vectors, animals, and humans, the integrated ecology of infectious diseases, was taken into account and could be further elucidated.

I think if you go to most universities where there are excellent microbiology departments and virology research programs, you'll find them focusing mostly on molecular virology, something which my own research group which works on hepatitis C tends to do. In contrast, here on the UTMB campus, we have a large number of scientists who are very much aware of, knowledgeable about, and able to work on the interaction between viruses, humans, insects, and animals. That's the continuum from which these emerging infections evolve, and it just so happens that most of the agents that we worry about in the context of bioterrorism are agents that are vector borne or that normally cause disease in animals. These are the pathogens that the terrorist would like seek to facilitate transmission to humans—anthrax is a good case in point.

So in 2001, right after the 9/11 attack, and before the anthrax events, we created the Center for Biodefense in recognition of the possibility of bioterrorism. Since then we have received several very large research grants from the National Institutes of Health, which I'll go through briefly, to help support that kind of research at UTMB. I'll tell you a little bit about what we're doing with those funds here at UTMB in response to this national crisis.

At present we have about six research programs or centers that are focusing on the problem of emerging infectious diseases, including two World Health Organization Collaborating Centers, that are working together under the rubrics of an newly established institute, the Institute for Human Infections and Immunity, here on the UTMB campus.

These include the Center for Biodefense and Emerging Infectious Diseases, which is the largest, that is focused primarily on the threat agents related to bioterrorism, but also is carrying out research on naturally emerging infectious diseases such as the H5N1 influenza virus I'll talk about more momentarily. This center is supported primarily by a very large, approximately $50 million, grant from the National Institutes of Health: the Western Regional Center of Excellence in Biodefense and Emerging Infectious Diseases. This grant supports research at UTMB as well as a variety of other partnering institutions in the six-state region, as you can see here on this slide, all within this five-state region.

The critical thing to mention here is that one thing we have really learned about and come to appreciate is the power of collaboration. This consortium involves UTMB, Texas A&M, UTHSCH, UT Southwestern and virtually every one of the major institutions in this part of the country that are typically competitors for federal awards. Under this grant, they work together in a very good and positive way, taking the strengths of each to apply them to the problems before them. Now, you can see here

this grant is bringing in about $12 million this year from the National Institutes of Health to Galveston. But you can see that less than half of those funds actually remain in Galveston, whereas the rest are being subcontracted out to our partner institutions to allow this to happen.

This Western Regional Center of Excellence grant is supporting the development of vaccines, diagnostics, and drugs (therapeutics to act as countermeasures to these biodefense threats) primarily the so-called Category A select agents. You'll hear more about that from Dr. Peterson shortly.

In addition to the UTMB Center for Biodefense and Emerging Infectious Diseases, we have the Center for Hepatitis Research that also operates also under a consortium grant from the National Institutes of Health (in partnership with UT Southwestern, the Southwest Foundation in San Antonio, and Johns Hopkins), as well as a contract to our institution here for testing antiviral drugs for the NIH that might have activity against hepatitis C virus specifically. This has been a very successful center, in operation here at UTMB since 1997, generating a great deal of new information about the virus; new ways in which you can grow the virus in cell culture and test the virus for it susceptibility to new drugs as they're becoming available.

The hepatitis center, which I direct, is part of a national network of such NIH-funded centers—and this is one of the first centers in the network—is going to be very a important part of a new generation of therapeutics that will be coming available for hepatitis C in the next few years. I point out this example to show that we're doing more than biodefense, much more than just bioterrorism-related research at UTMB. We are addressing not only hepatitis C, but a whole panoply of emerging infectious diseases.

We have the Sealy Center for Vaccine Development that was founded under Dr. Stanberry's leadership with the use of institutional funds from the John Sealy Memorial Endowment for Research, but which has since achieved substantial funding from the NIH and the Department of Defense to support the development of vaccines at all phases. It is now also supporting through an arm's-length relationship, the "National Network for Immunization Information", which is a leading global source of valid vaccine information. They run a fantastic website. It's been on this campus, or associated with this campus, for a little over a year-and-a-half, and has been cited for excellence by the World Health Organization.

Then there are the two World Health Organization collaborating centers, one focusing on Tropical Medicine and the other on Arboviruses and Encephalitis Viruses. Now, to be a collaborating center means you are recognized by the World Health Organization for your specific expertise, your excellence, and your ability to help the rest of the world to deal with these issues.

We are very fortunate to have a generous endowment, the James W. McLaughlin Endowment for Infection and Immunity, that was bequeathed

to UTMB in the '50s and that has supported over 400 students and research fellows working in this area over the past half centruy. It's been a real bedrock of support for us, helping provide support for many worthy trainees.

Then there is the $110 million grant from the National Institutes of Health to construct the Galveston National Laboratory (GNL), the construction that you see right outside the building here. I'll tell you a little bit about this building. I want to say at the outset, though, that this is a building that's going to cost much more than that $110 million. The overall cost will be closer to 170 million before we're done. And we've been very grateful to the number of foundations that have very graciously helped support this activity here on the UTMB campus, as well s the university in its support for the $57 million required in matching funds by the National Institutes of Health.

I want to be sure to mention the Brown Foundation, the Fondren Foundation, the Keck Foundation, and the Kleberg Foundation, because the generosity of these foundations has provided us with the ability do the kind of things that we're going to show you this afternoon.

This slide shows the construction site for the GNL. This will be a building that will be seven stories tall when it's complete. And it will connect with this building just to the north of it that right now is the most sophisticated biocontainment laboratory in the southwestern United States. When this building is complete there will only be two other research facilities, biocontainment research facilities, with equal sophistication to this in the entire United States, one of those being the U.S. Army Medical Research Institute for Infectious Diseases at Fort Dietrich, and the other being the BSL4 laboratories of the Centers for Disease Control in Atlanta. Another such laboratory is being planned by Boston University, and if it is successfully constructed, together with the GNL, these two laboratories will be the only non-federal laboratories with that level of expertise and capability in the U.S.

You can see here that GNL is going to really dwarf the Keiller building that currently houses our biocontainment laboratories that will sit right next to it. Here is the Robert E. Shope BSL4 Laboratory, our current BSL4 (maximum biocontainment level) research laboratory and the only one of its type on an academic campus in the U.S. Now, BSL4 space is the kind of research laboratory space that you may have seen in the movie Hot Zone, in which individuals work in what looks like spacesuits. You saw a little bit of our existing BSL4 space in Glenn's movies at lunchtime. The GNL will have a substantial greater amount of BSL4 research space, as well as BSL3 research space (a lower level of containment for potentially airborne pathogens).

BSL4 biocontainment laboratories are very rare, and the scientists that know how to work within them, even scarcer. There are probably less than a hundred well-trained scientists worldwide that know how to work safely and have deep experience in these kinds of facilities. And we figure

we have about 10 percent of that world's population, if not more, here at UTMB right now.

This is a research facility that is designed to be as secure as possible. There's two double concrete walls, airtight walls, that separate the inside of the facility from the outside. The virus is actually handled within special biocontainment cabinets within the laboratory. The individuals work in suits with air being fed into the suits to protect them against the inadvertent escape of even a small amount of virus that might come out of these biosafety cabinets. At almost all times, there is no contamination of the air in the facility. The suit is just one of a series of redundant protection mechanisms, each very important, to keep the infectious agent in the lab, and to protect the worker from it.

When individuals leave this laboratory they go through a chemical shower. They're in the shower for about seven or eight minutes so that anything that may have been deposited on the surface of their suits is washed off. This is serious stuff. The viruses that they're working with within this facility are viruses that are potentially fatal if an infection occurs. And they're viruses for which there are no vaccines and no antibiotics; no ready cure let alone treatment.

So it's essential to have this kind of containment in order to do the research that needs to be done to develop the vaccines and the antiviral drugs we need to take these kinds of agents and put them on the shelf. These are thus very sophisticated laboratories with a tremendous amount of engineering above and below the research space to take care of the waste that comes out of these facilities. All the waste is cooked or filtered before it leaves the facility and to make sure the air going in and especially coming out is sterile.

We have substantial training facilities: this slide shows a mock BSL3 laboratory, and this an engineering mockup of a BSL-4 lab control system. Our ability to train scientists and engineers in BSL3 and BSL4 biocontainment practices here is recognized nationally. We've been sought out by other universities or federal agencies that with to develop expertise in this area. In fact, right now we are training the future lab manager for the National Institutes of Health BSL-4 lab which is to be constructed in Montana.

So that, then, is the background within which we're working here. Now, I'd like to spend the last five minutes here of my time talking a little bit more about bird flu (or "highly pathogenic H5N1 avian influenza", as the virologist would call it) and to try to put what I've told you already into specific context with this infection. We are poised to work with the avian flu virus here on campus now. Adjacent to the GNL construction site, the Robert E. Shope BSL4 Laboratory which I described previously provides us with the capacity to do research with this virus. And research is urgently needed for a vaccine or therapeutic for this very real, natural infectious disease threat.

As of the middle of this week there have been 133 cases of H5N1 influ-

enza reported in humans in Asia. Of those 133, 68 have died. These were almost all children and young adults who were in close contact with poultry. If you look retrospectively—and some scientists with foresight, like Dr. Rob Webster at St. Jude, have been following this for some years—this virus has been expanding in both wild and domesticated bird flocks in Asia, such that now this virus is widely disseminated throughout all the chicken and duck populations that are being raised in Asia, and, moreover, has spread into the wild waterfowl populations. So now it's being carried by migratory birds.

This virus H5N1 is a typical influenza virus. And what many of you might not realize is that flu, the influenza virus that comes around every year, is basically a bird virus. Humans get it as a bit of an accident. It's not primarily a human virus, it's another "zoonotic" virus. But there are strains that have become relatively well adapted to humans, and that's what we see every year.

Now, occasionally one gets genes imported from influenza viruses infecting birds into the human virus pool. And when that happens we have the potential for a very substantial epidemic, or what we call a pandemic. The last two pandemics happened in the '50s, and about '68, when Asian flu and the Hong Kong flu viruses suddenly appeared on the scene, both ostensibly from sources in Asia. Now, those were serious outbreaks, but they were nothing like the 1918 "Spanish influenza" outbreak that was much more lethal.

What we know now about the current H5N1 virus is very sobering and this information has only been determined in the past few months. These newly derived data suggest that the 1918 virus was actually very similar in many ways to the H5N1 bird virus now circulating among birds (with occasional transmission to humans) in Asia. It was a bird virus that jumped quickly (and for still unknown reasons) into human populations.

The H5N1 has been expanding among avian flocks in Asia, jumping occasionally to those having close contact with infected domesticated ducks and chickens. As I have said, it has to date killed about half of the individuals that it has infected. I think the average age is about 11 years for those who have died—that is, mostly children. So this is not a virus that is attacking the elderly, those with respiratory infections, or the immune-compromised as you might think of flu doing normally. It's attacking normal healthy people in Asia, as I said before, almost always those in very close contact with birds.

Now, if we look back over the past few years we can see that the birds have been sustaining greater and greater numbers of infections with this H5N1 virus, both in wild as well as domesticated aquatic and terrestrial birds-- ducks and chicken. The latter numbers have become truly extraordinary in the past year. Unlike the normal avian influenza viruses, this highly pathogenic H5N1 virus is killing the domesticated birds at a very high rate, and it has also begun to kill the the wild waterfowl as well. That's very unusual.

I referred previously to the 1918 epidemic, which was really horrendous. This is a picture of a makeshift hospital at a camp in Kansas in September of 1918. This virus emerged at the time of World War I and it spread rapidly around the globe. No one's actually sure how many people were killed. The estimates run anywhere from 20 to 50 million. In the United States it was somewhere close to 700,000, a huge number for USA, which had a much smaller population in 1918 than it does today.

As with the H5N1 flu we see in Asia today, almost all of the deaths were in individuals under the age of 45. These were not the elderly that we normally think of as being at risk with flu. That's something we just don't understand. This virus appeared to cause an unusually aggressive infection when it entered a normal healthy adult, leading to respiratory failure and death, often within 24 hours - very, very fast. Now, although it's controversial, and there is a lot of debate about it, I think many of these cases were probably due to primary flu infection and not a secondary bacterial infection, although that's debated.

Very recently, investigators at the Armed Forces Institute of Pathology at the Walter Reed Army Medical Center in Washington have been able to recover the genetic material from the virus that killed a woman who died of flu in 1918 in Alaska and who was buried in the permafrost. They were able to recover the genetic information from the lungs of this individual and determine the genetic sequence of that virus in 1918—a bit of viral archeology if you would. And, as I said, we know now that this virus was, by all its genetic fingerprints, a bird virus that suddenly was able to achieve the ability to be transmitted to and among humans.

You can see the impact of this infection in 1918 on the mortality rates in the United States. The average life expectancy dropped significantly in the U.S. as a result of that pandemic. And you can see here that the death rate due to infectious diseases just about doubled. If you put that death rate against the current death rate, either infectious or all causes, you could see it would be an enormous increase.

The human cases of H5N1 influenza that have appeared in Asia so far have a number of very important features. First of all, as I mentioned, the case fatality rate is very high, about 50 percent of the infected persons have died as a result of the infection, even though some of these patients were treated with Tamiflu, which is an antiviral that has activity against most strains of this virus in cell culture. At present it looks as though almost all of these individuals have acquired their infection from birds, usually from close contact during the slaughter of chickens or eating chickens that may have been infected and not adequately cooked.

But there's at least one incident, one cluster of cases that occurred in Viet Nam within a family where it looks as though the virus may have acquired the ability to be transmitted between members of the family. And that's the thing that virologists and public health experts are all worried about; that is, the potential for the virus to acquire the ability to be easily transmitted between people. That would make the difference between

what we have now, a very serious public health menace in Asia, and what would be a global health emergency.

Right now the H5N1 virus lacks the ability for efficient spread among humans, although it spreads readily among birds. Some virologists feel that that ability is only a few mutations away and that the clock is ticking. The problem is only we don't know exactly what time it is. Other virologists feel, well, that the virus hasn't been able to achieve this ability to be readily transmitted among humans yet, so it may never do be able to do so. Unfortunately, only time will tell us which group of scientists has it right. So if you look at pandemic flu it's a bit like hurricanes. You know they're a threat, you know it's going to happen sooner or later, but you don't know if it's going to be this week or next week, this season or next season.

Nonetheless, the World Health Organization has put together a color-coded panel of pandemic threat. Staring over here on the left is Phase 1, when there's no new virus in humans and those in animal populations have a low risk and over to here in Phase 6, where you're in a frank pandemic with increased and sustained spread in the general population. On this scale, we're probably in Phase 4 right now. We have extensive spread among animals. We have limited spread among humans, small clusters and localized. And the question is where it is going the rest of this year and next year...

Now, how could H5N1 reach Texas? After all, we're a long ways from Asia. Well, migratory birds are probably the most likely way in which that could happen. But bear in mind we have a number of direct flights from Dallas and Houston to Asia and that an infected individual, be he or she infected with the SARS virus or with avian influenza, if we got to that point in the pandemic, could arrive here very suddenly unbeknownst to us.

In addition, there's always the potential for birds to be imported, even smuggled, into this country and other countries. Birds with H5N1 infection have been recognized in quarantine at Heathrow Airport in London recently and exotic birds were discovered in Brussels recently that were being smuggled into Belgium wrapped in a rug. They weren't infected, but it just shows the risk that you have for bird traffic.

Now, if you look at the major flyways of migratory birds, you can see that they are global in their span. Many of you probably know this, those of you that are bird watchers and follow bird movements. But you can see that from infections among waterfowl in Southeast Asia, there has been a spread of the H5N1 virus in flocks along migratory routes up into central Asia into Turkey. It seems very clear that the virus is in the flyways moving with the birds.

The question for us to ponder is whether the H5N1 virus will reach the United States via an airplane, or instead travel on feathered wings via the east Asia-Australian flyway, and then the Pacific-Americas flyway into central southern United States, as shown here. There's a real need for us to begin doing more effective surveillance for this virus in the United States, including Texas.

Now, a few weeks ago I had the interesting experience of hearing the President of the United States present a half-hour lecture on pandemic flu at the National Institutes of Health, and along with it a summary of the federal government's pandemic preparedness plan. The President's plan is based on three pillars. One is preparedness in communication. Another is surveillance and detection, an area where we need to have a great increase in our ability to do these things. The third pillar is response and containment, another area where we are woefully inadequate at this point in time.

What types of countermeasures do we have available in the event of a pandemic? The NIH has actually made a vaccine against H_5N_1, that is about 2 million doses of it, and it's been tested. It works, but it requires a high dose maybe two doses. So that's not a lot of virus vaccine to protect 300 million people in the U.S. If you look at the United States we have the capacity to make in any one year about 55 million doses of vaccine for influenza. So we can cover about a sixth of the U.S. population with our manufacturing capacity in this country. We need to do much more to be ready with a vaccine should a pandemic happen.

The President's plan calls for the procurement of a stockpile of the anti-flu drug, Tamiflu. It's not there yet, however, and when we do get it, we will only have 40 million doses. It requires a daily dose to protect an individual, and as I mentioned above its potential effectiveness as a therapeutic is not without question.

In the face of very limited countermeasures, what we can do is improve our surveillance and rapid reporting capacities. The CDC is working hard with the various state health departments to do that and to develop rapid response teams that have could antiviral drugs (and possibly vaccine) that could be shipped to a site in an effort to contain the infection, or delay its spread, if and when an outbreak of infection were to occur in the U.S.. But the challenge is to properly fund the human resources, and to carry out the planning, coordination, and cooperation required among multiple agencies. In this case, the Department of Health and Human Services, the Department of Homeland Security, the Centers for Disease Control, the NIH, the USDA, the Department of Agriculture—the list goes on and on just within the federal government.

So here in Texas we have been working with our partners, and it's been a very interesting and very pleasing experience thus far to work very closely with the group in Houston at the Center for Biosecurity and Public Health Preparedness and in College Station at the National Center for Foreign Animal and Zoonotic Disease Defense. We have been developing a concept for rapid, real-time surveillance of influenza in Texas, something that we have proposed to do in close coordination with the Texas Department of State Health Services and in partnership with a company from California called Ibis that has developed very novel technology called TIGER by which it seems possible to rapidly identify and type influenza viruses, in culture certainly if not directly in human and animal samples.

Without going into the details, this is a very complex, automated reverse transcriptase, polymerase chain reaction-mass spectroscopy device

that takes a sample and four hours later tells you what virus is in it. It gives you a pretty exact fingerprint of the genetic makeup of that virus. The output is rapid, it's real time, it's capable of high throughput, and the output is digital so it can be shared in real-time over the internet. What we propose is to site such instruments at a variety of locations so that we can sample the influenza viruses present in the community: in emergency rooms, in hospital and community-based practices, as well as in the avian species that are flying through the state, or that are being raised in the state for commercial purposes. Our vision is to have all these facilities capable of exchanging such data on a real-time basis, and to develop a network for surveillance that would be the envy of the rest of the United States and an example for the world.

That's the proposal that we're working on, and we are in the process of trying to make it a reality. Now, the reason we can do this is that we have the laboratory facilities that I've reviewed with you earlier, and we've had the support of the NIH and several generous foundations that have allowed us to pursue these activities.

So at this point I'd like to ask Dr. Scott Weaver to come up. Scott is a professor in the Department of Pathology and an expert on what are called alphaviruses. They're small RNA viruses that infect humans and are transmitted typically between animals and humans by mosquito populations. And he'll tell us all about it. Thank you.

DR. WEAVER: Thank you, Stan. I'm going to tell you a little bit about a virus that you probably haven't heard very much about before. It's a virus called Venezuelan equine encephalitis virus. And I think it's a nice example of, first of all, one of the viruses that we've studied here for quite some time at UTMB.

It's a virus that we've known for a long time has the capability of emerging naturally to produce large epidemics of disease in people and in equines, such as horses, donkeys, and mules. And we've also known for a long time that it's a very potent biological weapon. It was highly developed during the Cold War, for example. So this is a virus that, based on our expertise and experience prior to 2001, studying it as an emerging pathogen left us in a very good position to take a leadership role in the biodefense efforts to try to prevent this virus from being used by terrorists or rogue states in the future.

So why is this virus a biological weapon? Well, it has several properties that lend it to that use. First of all, we know that it was highly developed during the Cold War, both here in the U.S. and in the former USSR. It's readily available from natural sources. A terrorist doesn't have to break into a laboratory to get their hands on this virus. They can go out and get it in nature fairly easily. It replicates very well in cell cultures, and it's very stable. So it's a very user friendly virus from a laboratory standpoint. It's highly infectious by aerosol. And this is a property that most of the potent biological weapons share. In other words, if you generate an

aerosol of very tiny droplets containing this virus you can very efficiently infect large numbers of people. It produces a very debilitating, sometimes fatal disease.

It produces immunosuppression, so it predisposes people to a secondary infection, with a bacterium, for example. And many people who survive the disease have permanent neurologic disease for the rest of their life. If you introduce this virus into the right place with mosquitoes and horses, for example, you can develop a secondary epidemic through the natural emergence process that I'll show you in a moment. And then there's no licensed human vaccine or effective drug against this virus. So we have no way to prevent infection or to treat an infected person. And, finally, we know that this virus can be manipulated using genetic-engineering techniques to probably make it even more virulent and to kill more people and horses if the person with the appropriate expertise went about this the right way.

So, in general, what can we say about the way that emerging infectious diseases occur? What are the factors that result in these emergences? Well, there are a number of them in common. One is deforestation. And the reason is that many of these viruses and some bacteria that we consider to be emerging pathogens have their natural home in forest environments, especially tropical forests. They're zoonotic agents, which mean that they normally infect wild animals, and people are not their natural hosts.

When we destroy their forest habitat we—first of all, we invade their territory, and, second of all, we sometimes force them to find a new way to be transmitted, which can be more dangerous for us. The second factor is that we're building large cities. And, in fact, many of the most rapidly expanding cities in the world occur right in the tropics. So we're putting large populations of people right in the middle of the territory where these viruses occur and offering the virus a perfect opportunity to find better ways to infect people.

As Stan mentioned, an infected person or an animal can get onto an airplane anywhere in the world, and within a day they can transport the virus or the bacteria to a new location to start a new outbreak if person-to-person transmission can occur or sometimes animal-to-person transmission.

Environmental changes that we make on the planet can have a dramatic effect on the ability of these viruses to spread and emerge. For example, this is a tire dump here. And we know that in 1985 a mosquito called Aedes albopictus colonized Texas, coming from Asia, in used tires that were imported for retreading in the Houston area. So this mosquito appeared in Houston in 1985 and has spread throughout much of the United States now. And we know that it's a very potent vector of many of the viruses that are considered threats in this country, such as West Nile virus and also Venezuelan encephalitis.

And, finally, as Stan also mentioned, the viruses and also the bacteria have the ability to evolve much more quickly than we can evolve our natu-

ral host defenses to combat the infections that these agents cause. So we can't keep up with them in our natural evolutionary processes. The only way that we can attempt to do this is with our science.

A Venezuelan encephalitis virus actually has a history right here in Texas. In 1971, through more or less a natural emergence process, this virus was introduced into South Texas. And over the course of about three months it infected about 300 people in South Texas and killed about 1,500 horses in the state. There was a massive vaccination program that actually extended almost throughout the United States and a massive mosquito control effort here in Texas spraying Malathion insecticide out of airplanes all over the coastal regions that was put into place to control this outbreak in 1971.

The history of natural outbreaks from the virus probably dates back to about the 1920s. And most of these outbreaks have occurred in northern South America, and they've involved up to several hundred thousand horses and people over a period of a few months to a few years. One of the outbreaks began in 1969 in Guatemala and El Salvador, and this is the one that eventually spread up through Mexico into Texas and caused that epidemic in 1971 here.

But the curious thing about this virus is that after it causes these massive epidemics it disappears for periods of ten, sometimes up to about 20, years and can't be found anywhere in nature. So for a long time the main goal of our research program was to try to understand where this virus comes from, how does it emerge out of nowhere, cause a major epidemic, and then disappear for decades after that.

And what we've learned is that the progenitors, the viruses that cause these outbreaks, actually are viruses that are found only in forest habitats. These are viruses that use small rodents as their reservoir hosts. These are the animals that are responsible for maintaining the virus over long periods of time in a cycle involving mosquitoes in a forest habitat. And these mosquitoes are a type of mosquito that very specific to forest habitats. It rarely ventures very far from a forest.

So, for that reason, this kind of cycle occurs more or less silently in tropical rain forest habitats throughout the New World neotropics and also in Florida in this country. This more or less silent cycle goes on without anyone's knowledge unless they go looking for it. And then periodically this virus finds a way by mutating to allow it to infect much more efficiently horses and to generate large amounts of virus in the bloodstream of a horse.

Once it mutates to allow it to replicate well in horses, horses can serve as very efficient amplifying hosts. And different kinds of mosquitoes, the kinds that you usually would find in a pasture-type habitat where you'd find horses, especially in coastal areas, are very efficient at biting an infected horse. After about a week of incubation they can either bite another horse to continue the cycle or they can bite people in a process that we usually call spillover. People are not really part of the cycle, but

they tend to live near horses so they get infected accidentally and often with very severe consequences. So this cycle can go on as long as there are available susceptible horses and lots of mosquitoes. And so the outbreaks usually occur during a rainy season in places where there are horses such as ranch habitats.

Now, we've been particularly interested recently in some activity of this virus in Mexico. So the history of activity of VE virus in Mexico, as I mentioned, began here in 1969 in El Salvador and Guatemala where a virus probably that actually resulted from the use of a bad vaccine escaped into the environment, spread up the coast here in this horse-to-mosquito transmission cycle, across the Isthmus of Tejuantepec, up here to the Gulf Coast, and then moved right up into Texas across the border in 1971 and caused that epidemic. That's the only recorded history of Venezuelan encephalitis activity in Mexico until 1993. And in that year another small epidemic occurred here in the coast of Chiapas state near the Guatemala border. Then another outbreak occurred in 1996 just to the north in Oaxaca State, also on the Pacific Coast, and another outbreak was detected in 2002.

There were a couple of important questions for us to answer about these outbreaks. First of all, what led to the sudden appearance of the virus in 1993? We know that the only previous outbreak was caused by the use of a bad vaccine. We didn't realize that there was the potential for natural emergence of this virus in Mexico, and we didn't really know how it could happen. The second question, most important to us and to the USDA, was what was the potential for spread into the U.S. because you can see that the locations of these outbreaks are right along the path that the virus spread up into Texas in 1971.

We have a major research program in this area to try to understand what's going on now in Mexico. And it's turned out to be quite interesting. What we've learned, partially through collaboration with a USDA scientist who specializes in using satellite imagery to study infectious diseases, and also from our own field studies, is that the area where these outbreaks occur here on the coast, the Pacific Ocean is here, on the coastal plains of Mexico has been severely deforested during the past few decades.

This a satellite image that doesn't contain colors like you would see with your naked eye. These colors represent different portions of the infrared spectrum. And the red and orange colors here represent heavily forested areas that remain in the mountainous areas just north and east of the coastal plain. But the green and blue colors here represent pastures primarily and other disturbed habitats in the coastal plain. So you can see that there's almost a complete absence of forest now in this area.

What we've learned has happened is that originally there were forest cycles, like I showed you in the cartoon a moment ago, where the virus was transmitted by rodents by a certain mosquito that lived in forests here on the Pacific coast of Mexico and Guatemala. But the habitat for this mosquito, called Culex taeniopus, was destroyed here. Basically we forced

the virus to find another way to be transmitted by mosquitoes. In other words, we told the virus, you have to adapt to another mosquito if you want to survive here.

Well, what mosquito might that virus use instead of the forest vector? Well, we've discovered that it's this mosquito, Aedes taeniorhynchus. Why would the virus pick this mosquito? Well, there are several reasons for this. First of all, it's the most abundant mosquito in the coastal areas of Chiapas state and Oaxaca state in Mexico. Those of you who are from coastal areas here on the Gulf Coast of Texas are very familiar with this mosquito because it's also usually the most abundant mosquito anywhere near salt marshes in this part of the world. It was probably the most important vector in 1971 when the virus came here.

Unfortunately, this is a mosquito that, instead of preferring to bite rodents in forest habitats, it prefers to bite large mammals like horses and people and it lives outside of the forest in marsh areas and pasture areas. And it's a highly efficient vector for the epidemic transmission from horse to horse and horse to person. What we've discovered in the process of studying the genetics of the virus is that the virus very recently adapted to infect this mosquito more efficiently and to use it as a vector in Mexico. So we've forced the virus to come up with a solution to continue its transmission cycle that's detrimental to us because the vector now is more likely to bite people and horses.

Now, how does this mutation that we discovered affect the ability of the virus to infect a mosquito or to infect horses and people and cause disease? Well, that's a very difficult question to answer. But we're starting to make some progress on that. What we have discovered by doing some structural studies using a process called cryoelectronmicroscopy we've determined the structure of the virus particle here. Here it's magnified for you about a million times to a resolution of about 8.7 angstroms. This is the highest resolution that's ever been produced for an alpha virus, a member of this group of viruses.

What we can see here by color coding different parts of the virus is that the red part here on the surface that forms these projections or spikes here is called the envelope glycoprotein number 2. The mutations that allow this virus to infect mosquitoes better and to infect horses better lie on the surface of this E2 protein. This is actually a reconstruction done with the vaccine strain of the virus, which is safe to handle in a normal laboratory environment. In about two months we're going to be able to do the same kind of structural studies using the wild type highly dangerous virulent virus that causes the outbreaks.

The reason for that is that we're developing a new facility on campus, thanks to gifts from the Keck and Kleberg Foundations, that's going to allow us to put one of these microscopes for the first time anywhere in the world into a high-security level 3 environment here on our campus. So we'll be able to study almost any virus that's amenable to this kind of structural study in the high containment safe environment here on our campus.

To return to these themes about emerging viruses and pathogens and how Venezuelan encephalitis fits into this picture, I show you that these viruses have their origins in forest. So when we start cutting down their forest habitat, when we invade their territory, we do two things. We increase our own risk of infection and contact with the virus, but we can also force the virus to find a new way to be transmitted in a different kind of habitat. And that can have bad consequences for transmission to people and horses.

We build cities right in the middle of these habitats. For example, we do field studies in a place called Iquitos, Peru, which is a city of 400,000 people right in the middle of the Amazonian Rain Forest. And we've detected a lot of infections in that city with this virus. Although we haven't documented this in the past, just like many of these other pathogens, a person who becomes infected with this virus can get on an airplane in Maracaibo or Caracas, get off in Houston, and if they go to a ranch where there are mosquitoes and horses they could initiate the epidemic cycle right here in Texas very easily.

As I showed you, this virus through single mutations, which RNA viruses, viruses with a kind of genetic material that influenza and VE have, can mutate very rapidly and find ways to infect new hosts via these mutations.

DR. PETERSON: At UTMB in Galveston, we have built an Aerobiology Facility within our Animal Biological Safety Level 3 Suite for testing new drugs and vaccines against anthrax, plague, and other diseases acquired via the respiratory tract. In this brief presentation, I will illustrate some of the work that we have begun as a defense against the threat of bioterrorism and emerging infections. We have done a lot of extensive evaluation of a monoclonal antibody against anthrax toxin in small animal models of inhalation anthrax here at UTMB. But before I show you some of the data, I'll just show you some of the obstacles that we face in this type of research today. I'm not here to complain—it's just the facts of life in working with select agents.

We can't simply go into the laboratory today like we used to and start working with Bacillus anthracis or other select agents. Everyone in the laboratory, including myself, has to obtain a background investigation from Department of Justice, that is, a background check by the FBI. I'd already had one many years ago because my fiancé worked for the FBI. So back in J. Edgar Hoover's day, even the friends and spouses of FBI employees had to be investigated.

In addition, there are many, many obstacles to the work that delay our work, and inherently increase the costs. I'll just show you some of the types of special equipment that we use to protect ourselves. We wear Tyvek suits with battery-powered respirators that filter the air that we breathe. All of our work is performed in restricted access BSL3 facilities, which have a high-level of biocontainment that Dr. Weaver mentioned.

All the air in the facility is filtered through large HEPA filter units. It's

quite a redundant process to ensure safety. Our biosafety cabinets have gloves so that my personnel and I can work inside this protective environment. Our Class III biosafety cabinet is connected to a lower-level Class II biosafety hood.

We have aerosol equipment into which we place small animals and infect them by the respiratory route. Then, we evaluate the effectiveness of therapeutics and vaccines. The infected animals must be housed in special ventilated cages that have HEPA-filtered air input, as well as HEPA-filtered air exhaust.

Figure 1 illustrates some of the periodicals showing the personal protective equipment worn by first responders helping in the cleanup following the intentional release of anthrax spores in Washington D.C. and New York City. The weaponized spores were distributed in the U.S. Mail in letters to public officials [see Figure 1]. A total of 5 Americans died from inhalation anthrax among approximately 18 with clinical symptoms.

At UTMB in Galveston, we have research programs dedicated to the development of new diagnostic tests, novel drugs, and improved vaccines against anthrax and several other bacterial and viral agents of bioterrorism. Importantly, UTMB provides training to students, who become tomorrow's scientists [Figure 2].

Along with my colleagues at UTMB, Drs. Catherine Schein, Scott Gilbertson, and Alfredo Torres, we are developing a new drug that blocks the edema toxin secreted by *B. anthracis*. Figure 3 illustrates the molecular structure of anthrax edema toxin. By neutralizing the lethal toxin, the virulence of *B. anthracis* is reduced. The model shown is from Dr. Schein's structural research in which she and her team dock inhibitory compounds in the active site of the toxin. Dr. Gilbertson is an organic chemist who has synthesized several hundred related compounds in an attempt to develop superior antitoxic drugs.

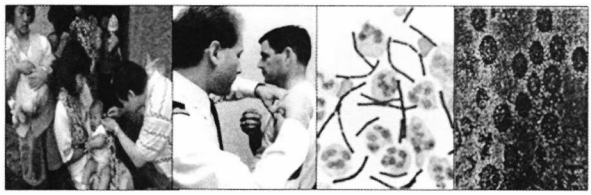
Figure 4 summarizes the method used by one company (Avanir Pharmaceuticals, San Diego, CA), with whom my laboratory collaborates, to evaluate a new human monoclonal antibody against protective antigen from *B. anthracis*. Basically, the lymphocytes from human volunteers immunized with Biothrax vaccine are cloned and the antitoxin gens are then expressed in a cell line (Chinese hamster ovary cells). The human anti-PA antibodies are overexpressed and purified to homogeneity. We have been testing the protective capacity of these human antibodies in small animal models of inhalation anthrax.

But before I show how protective these antibodies are for experimental animals with inhalation anthrax, what kind of problems do we face due to new federal regulations? Figure 5 lists some of the rules and criteria that we must meet in order to perform studies with *B. anthracis*. First, all personnel, including myself, must have a security clearance from the U.S. Department of Justice (FBI background check) that can take up to 9 months. As a qualified scientist, I must have completed a select agent registration application, arranged for one or more laboratory inspections,

Fig. 1. Why is Research on Bioterrorism Needed?

Fig. 2. Research in Support of Biodefense at UTMB Galveston

- We are preparing and evaluating new diagnostic tests, novel drugs, and improved vaccines to help us defend against agents of bioterrorism
- We also provide training to students and fellows to become tomorrow's scientists



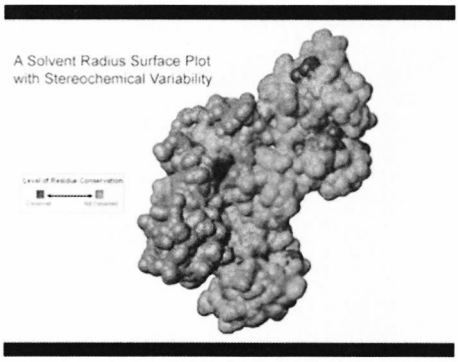
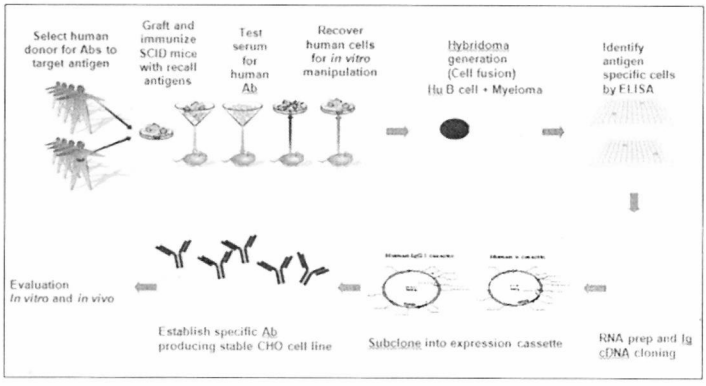


Fig. 3. Structure of anthrax edema factor.

Fig. 4. One example: a new therapy for Anthrax AVP-21D9 Synthesis Xenerex™ Technology



and arranged from controlled shipment of the agent with appropriate federal agencies. Each academic institution must arrange for building security, review of scientific work by an institutional biosafety committee, and maintain current registration status. As an investigator, it is my responsibility to acquire funding to purchase appropriate safety equipment for handling these pathogens, acquire HEPA-filtered housing the infected animals, and ensure that all personnel are properly trained and attired for performing the work. All animal research is overseen by a faculty committee known as the IACUC.

Figure 6 shows the positive pressure respirators worn by UTMB personnel in the Aerobiology suite where pathogens are aerosolized under carefully controlled conditions, using the latest biosafety equipment to minimize risk to personnel and the environment. Figure 7 shows some of the biosafety glove cabinet equipment that is used to protect personnel and the environment from the aerosolized pathogens. Figure 8 shows some of the HEPA-filtered ventilated safety cages for housing infected animals while testing new drugs and vaccines.

Finally, we get scientific results! In Figure 9, we demonstrate that the human monoclonal anti-PA antibody mentioned earlier was highly protective against lethal infection in the rabbit model of inhalation anthrax for 5 weeks and then was still protective against rechallenge for at least two more weeks. Complete protection against death was achieved with as little as 1 mg/kg of body weight. Partial protection (50%) was achieved with as little as 0.5 mg/kg (data not shown). Figure 10 indicates interesting data from other rabbits infected with B. anthracis via the respiratory tract with or without protection by the human monoclonal anti-PA antibody. The results indicate that the animals have few symptoms before death. For example, we did not measure any rise in body temperature in any of the animals. Further, the data indicate that the human monoclonal anti-PA antibody blocks dissemination of the bacteria from the lungs to the blood stream, while most positive control animals develop bacteremia. And die within 60–72 hours. The anti-PA antibody is highly effective in protecting against death in the animals.

The final Figure 11 shows some of the students and personnel working on the anthrax project. We are very grateful to them for their many hours of hard work and the NIAID and the U.S. Army for providing funds to support this research.

Fig. 5. Okay, so let's do some science!
But wait, first we need to get...

- DOJ clearance 8-9mo
- Select agent permission
  - Lab inspection 3-6 mo
  - Select agent application 5-6 mo
  - Shipping arrangements 1-2 mo
- Local biosafety clearance investigator
- Employee health sign-off
- OSHA training PPE
- IBC clearance for recombinant DNA 1-2 mo
- IACUC permission for animals 1-2 mo

Fig. 6. Personal Protective Equipment Used with Aerosolization Equipment in the UTMB ABSL-3 Facility

1. 3M® Breathe Easy HEPA-Filtered Tyvek Hood and Respirator
2. Tyvek suits over surgical scrubs
3. Tyvek boots over shoe covers
4. Double latex gloves

Fig. 7. Animal Biological Safety Level III Facility Equipped with Biological Safety and Aerosol Equipment

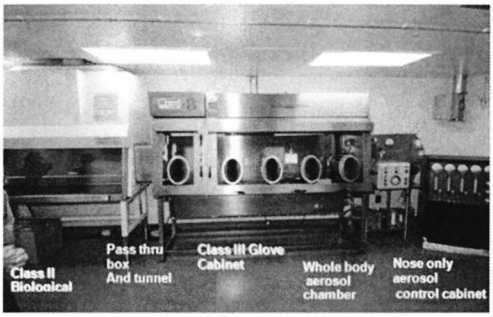


Fig. 8. HEPA-Filtered Ventilated Racks for Animal Housing

Fig. 9. Results!! Protection Afforded by AVP-21D9 to Rabbits Challenged with a 100 LD_{50} Dose of Anthrax Spores

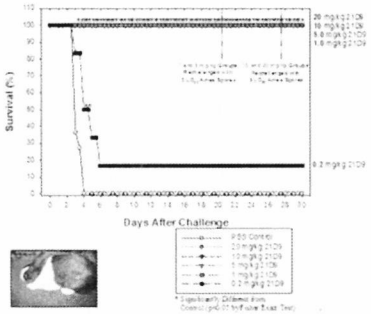


Fig. 10. Blood Culture Results from Treated and Untreated Rabbits Challenged with 100 LD_{50} *Anthrax** Spores

	PBS CONTROL			AVP-21D9 (2 mg/kg)*		
Time of Sacrifice Post Infection (hr)	Temperature (°C)	Positive Blood Culture (14 days)	Anthrax Confirmed γ-phage susceptibl	Temperature (°C)	Positive Blood Culture	Anthrax Confirmed γ-phage susceptibl
0 (uninfected)	---	---	---	---	---	---
12	39.5	*1/3*	0/1	39.9	*1/3*	0/1
24	39.6	*1/3*	1/1	40.9	*0/3*	0/0
36	41.0	*3/3*	3/3	40.1	*0/3*	0/0
48	39.4	*1/3*	1/1	39.5	*0/3*	0/0
60	39.2	*3/4 (1/4 dead)*	3/3	39.0	*1/3*	1/1
72	---	*2/2 (2/2 dead)*	2/2	38.5	*0/3*	0/0

* AVP-21D9 given s.c. at the time of spore challenge; n=3 rabbits/group

Figure 11. UTMB personnel working on anthrax (2005)

Discussion:

DR. LEMON: We now have 10 or 15 minutes open for questions. I'll ask my two colleagues to join me here in the center. Perhaps I'll act as emcee and take any questions that we have from the audience on any of these three presentations.

AUDIENCE: How does one destroy an infected animal to prevent further spread of infection?

DR. WEAVER: Are you talking about Venezuelan encephalitis or mad cow disease?

Audience: Mad cow.

DR. WEAVER: I think they're generally incinerated right on the farms where the outbreaks occur.

AUDIENCE: I was told that didn't destroy the prions. The heat did not destroy the prions. Is that right?

DR. LEMON: If you are looking at prions in an infectivity assay, it's correct to say that they are very heat-resistant. But they would have to be introduced into the bloodstream of an animal to initiate a new infection. And their ability to survive at the very, very high temperatures of incineration would be minimal. Under conditions of autoclaving, like we normally use for sterilization, they would likely survive. But I think incineration where you're reducing it to carbon, basically, there would not be much infectivity left.

MRS. ASHBY: Dorothy Ashby of Houston. Do we understand why viral outbreaks do not occur between May and October? And also I understand the Japanese have enough Tamiflu for 40 percent of the population, and we certainly don't have anything like that. Is there a reason?

DR. LEMON: You're talking about influenza here, of course. Influenza is primarily a disease of cold seasons. We think this is because people are indoors and they're more likely to be exposed to other people's exhaled aerosol. So that facilitates transmission. In terms of the Tamiflu situation, I didn't have a chance to say much about antivirals. There are two antivirals that are effective against influenza that are licensed in this country two classes of antivirals.

One is amantadine or the adamantine class. This is the older drug that is typically used and has been used for many years. The H5N1 virus is generally resistant to amantadine, probably because it's been used in poultry herds in Asia prophylactically. The other drug, which is newer and

more expensive, is Oseltamivir, or Tamiflu. Several countries purchased large stockpiles of Tamiflu beginning some months back. I think the Japanese were the first to acquire it for basically their entire population.

There's only a single company that manufactures Tamiflu. It's not easy to manufacture; it's a complicated, expensive manufacturing process that's under patent. Several other countries have opted to buy large stockpiles of Tamiflu. And the United States recently has decided to acquire somewhere around 80 million doses. I believe the President called for a federal stockpile of 40 million and another 35 million to be made available to the states under partial federal subsidy.

It's going to take a while to make that. It may require the construction of a factory here in the United States to actually manufacture the Tamiflu, because it's not manufactured normally in the U.S. So it's a question of supply and demand. Right now the global demand is huge. It's expensive, and relatively few governments have made the commitment, or made the commitment early on, to acquire it. But, remember, as I said before, it is not a panacea.

AUDIENCE: I have two questions. One, I wanted to comment about the challenge to evaluate drugs and vaccines against select agents, whether it was possible to get data supporting licensure when you do not normally have human infections, and what strategy you have. And, second, I wondered whether you could comment on the probability that you can create a vaccine against the bird virus which will be effective after a mutation takes place, which is likely.

DR. LEMON: Good question. I'll let Johnny answer the easy question first.

DR. PETERSON: Well, the Food and Drug Administration established a so-called two animal rule for diseases where it would be unethical to challenge humans with an agent like anthrax. So we will never be able to evaluate these compounds in a clinical study because the natural incidence of the disease is so low that that we can only challenge animals and infer from the best animal models that we have. Consequently, we use three small animal models to evaluate treatments for anthrax: the mouse, the guinea pig, and the rabbit. There are other laboratories in the country that use Rhesus macaques or other non-human primates for this. The Food and Drug Administration will consider results from two successful animal models if they mimic the disease in the human. But safety testing would have to be done in humans.

DR. LEMON: One of the complications there, of course, is that the FDA will be looking for data that were acquired under GLP rules—that is, Good Laboratory Practices—which is enormously expensive and which no university in the United States is well equipped to deal with right now. We're working hard to try to acquire that kind of capability, but it's expensive. It will be time consuming to get there.

As to your second question, you're referring to the fact that influenza mutates rapidly, particularly in its antigenic hemaglutinin protein, which is the major protein on the surface of the virus against which antibodies that confer immunity are directed. And one of the big concerns has been, if we make an H5N1 vaccine now, like the 2 million doses that the NIH has manufactured, how will we know that that vaccine will protect against the real pandemic strain if it acquires the one or two additional mutations needed to allow it to really be transmitted efficiently?

And the answer there is we just don't know. I think most believe that there would be some level of protection even if it's not a perfect antigenic match. Previous exposure to a vaccine against an H5 hemaglutinin would provide some efficacy. The H5 protein, of course, is something we haven't seen in humans previously. So all of us have no experience with that antigen. It would be a novel infection. Any H5 vaccine would probably provide some level of protection. But, optimally, you'd have to wait to identify the pandemic strain, isolate it, grow it, and prepare a vaccine from that before you have a good vaccine a really good vaccine. That could take many months and might be too late to impact on spread of the infection.

AUDIENCE: I've been waiting for someone to mention RNA interference. You said you're doing molecular work. I wonder if you can comment on what's going on there. Because that would answer this question if it would work, would it not?

DR. LEMON: Possible. RNA interference is a recently discovered phenomenon first identified in plants and more recently recognized to occur as a major gene-regulating process in mammals. It offers some really unique strategies for control because, in theory, one can chemically synthesize a small piece of genetic information—a small "siRNA"—and administer that chemical and thereby disrupt the replication of an RNA virus like flu. And, in fact, there are experiments that have been done in mice that suggest that this might work.

The challenge has been to be able to chemically stabilize the siRNA and formulate it as a drug as a medication. There are probably three companies that are making great progress in doing that in the United States. We're actually partnering very closely with one of them and have now two applications pending at the NIH to obtain NIH funding to test their siRNA compounds against influenza, as well as hepatitis C and other viruses. Good question. Yes, in the far back.

AUDIENCE: I'm curious if it would make any difference in thinking about people traveling, particularly in close quarters in an airplane, on elevators, and places where people are close together breathing the same air, but that air has not been circulated you're not getting fresh air. It would cost more for an airplane to keep providing fresh air at the correct temperature. But would taking measures like that make any difference at all?

DR. LEMON: My guess is that if you put really efficient, high efficiency HEPA filtration systems on planes to take care of recirculating that air through very efficient filters, or even introducing new air, which, as I understand it, would be very expensive in terms of fuel consumption for jet aircraft, that you still would have limited impact. This is because if an individual were to be infected and were to cough and produce an aerosol impacting individuals in close proximity they would likely become infected.

The airplane environment is a major and highly specialized concern. The CDC has recently promulgated new quarantine regulations that will call for the airlines' maintaining passenger lists to identify who's been on planes for some period of time after the flight has occurred—something that they can't do now that the airline industry is saying will be very expensive to put into place. So it's one of those areas where technology is working against us. In many of the examples you've seen here we're suffering from the downside of technology and not the upside. Do you have a comment on that, Johnny?

DR. PETERSON: May I make a comment? One of our medical residents, who was also an astronaut, did a study on American aircraft. And it was surprising to me how many of them use HEPA filtration systems now. Maybe they're not all equipped, but I think this is something that will increase in the future. And there's a lot of concern about downdraft of the air.

DR. LEMON: How good that is though, to protect you against the person next to you coughing?

DR. PETERSON: I still got a bad bronchitis the last time I went to London.

AUDIENCE: With respect to influenza vaccine we still seem to be stuck in the era of biologics. And I'm wondering if you could tell us what keeps us from moving into more modern vaccine development technology for influenza vaccines. And are we stuck with just the surface antigens or will the eight or so core antigens be of any use?

DR. LEMON: It's a very good question, one that I keep asking myself as someone who hasn't worked primarily in the flu field. Our current vaccines are made by growing virus in eggs and it requires a long lead time to produce the eggs to make the vaccine. And then the virus is inactivated and sometimes fractionated.

It should be possible to produce by recombinant genetic engineering a purified protein vaccine of just the protein of interest, the hemaglutinin and the other key protein, the neuraminadase. However, such vaccines when they've been tried in the past have been poorly immunogenic, probably because the proteins haven't been properly folded or assembled into

the proper confirmation or haven't assembled into a particle. In the case of the hepatitis B vaccine, which is a tremendously successful recombinant, genetically engineered protein vaccine, the protein actually assembles into a large particle, which is why it's so immunogenic—so good at raising immunity.

And, yet, I think that with the genetic engineering, and the skills that we have today working with proteins, we should be able to create an artificial flu particle with the right kinds of protein on its surface. As part of the President's plan, there is a major focus on developing new vaccines and bringing flu vaccine production into the 21st century instead of using the 1950s technology that's now used. But it's a huge challenge. It takes years and many hundreds millions of dollars to bring a vaccine to licensure.

AUDIENCE: I had two questions. One was on the flu vaccine we have now. I've read some articles that it's really not as effective as it had been originally thought to be the current flu vaccine. And the second question was on your estimate on the probability that this avian flu will make the mutations that it needs to make to be transferred from human to human.

DR. LEMON: Well, the first question, I think there's been a lot of controversy about flu vaccine for many years. Its efficacy is not what we'd like it to be. I think the major question recently has been how best to use it. We normally give it to people that are at risk mostly older individuals, those that have heart disease or that are immunosuppressed. However, there is a strong school of thought that we ought to give it to young individuals, children, who are the major vectors for transmitting influenza in the community. If we immunize them, maybe we'll see decreased rates of disease in the elderly. And that's something that we could perhaps discuss afterwards.

And the second question, the chance of a pandemic, well, I think the best answer I have heard is that the clock is ticking but we don't really know what time it is. I honestly don't know. I have real concerns. This virus is undergoing continuing evolution as we speak. The rate of genetic change is accelerating. It has an enormous pool of different types of birds and mammals including not only humans but also swine and other domesticated mammals to replicate in. And it's probably only a matter of time before it achieves the ability to be transmitted to humans.

But if you ask ten virologists that question you'll probably get ten different answers. The one thing they would all agree on is that if it did become adapted to humans it wouldn't kill 50 percent of them, as we now see the virus doing in sporadic human infections in Asia. Most likely, it would rapidly become less pathogenic, perhaps with a much lower mortality rate, but one that would still be incredible against our usual annual experience with flu.

AUDIENCE: Would you comment on the recent article in, I think it was

National Geographic, about the dust storms in the Gobi Desert and Sahara that were blowing in across the Pacific Ocean and bringing grasshoppers to the United States?

Dr. Weaver: I don't think I have any knowledge about a relation of infectious disease to that kind of event, all I can say is that there are examples where changes in weather patterns have a severe effect on the emergence of diseases. Probably the best documented example is a virus that occurs in Africa called Rift Valley fever virus that's been studied extensively. One of the experts on this is a member of our faculty, Dr. C. J. Peters. This is a virus that very clearly emerges following periodic changes in climate in Africa leading to increased amounts of rainfall that can be detected by satellite imagery and by measuring greenness on the planet and so forth. Disease outbreaks can be fairly well predicted from climate change with that virus. And I think you'll see more cases of that kind of research leading to some predictive abilities in the near future. I just don't know of an example related to the dust storms you're talking about.

Dr. Stobo: Well, I want to thank Stan and Scott and John very much for a very exciting and interesting presentation.

NEUROLOGICAL RECOVERY

DR. STOBO: When we put the program together, we decided to have one of our strongest programs present the end. It's a real pleasure to introduce Ping Wu.

Ping Wu received her medical training in Beijing University in China. She came to UTMB to do her doctoral training in neuroendocrinology, did a post-doctoral fellowship in Florida, then went to Harvard where she was on the faculty for a while, came back to UTMB I believe in 1999, and has just done some spectacular work in the area of neurological recovery, particular work using neural stem cells.

Her work has been published in the most prestigious journals. It has received worldwide recognition. In recognition of her work she was awarded the American Spinal Injury Association Award and recently is the recipient of the John S. Dunn Distinguished Chair in Neurological Recovery from the Dunn Foundation in Houston. Ping, it's a pleasure to have you here this afternoon.

• • •

DR. PING WU [8]

DR. WU: Thank you. It is my honor to be here to present to you. This talk will cover two parts. In the first part, I will give you an overview of the new science community at UTMB. The second part will focus on my own stem cell research and give you a piece of how scientists are working with stem cells.

The first part was originally scheduled to be presented to you by Dr. Claire Hulsebosch[9]. Unfortunately, she cannot be here. She asks me to send her regrets for her absence. So I will be here on behalf of her and the hundreds of neural scientists, faculty, and staff in UTMB who are working with this institute for neurological recovery.

[8] Ping Wu, M.D. Ph.D. is Assistant Professor in the Department of Anatomy and Neurosciences at the University of Texas Medical Branch at Galveston and a Member of the Marine Biomedical Institute

[9] Claire E. Hulsebosch Ph.D. is Project Director of the UTMB Spinal Cord Injury Consortium and serves as Vice-Chair and Professor of Neuroscience and Cell Biology.

At UTMB we have a large population of neural scientists and clinicians, both nationally and internationally recognized research scientists and clinical programs. We have over ninety faculty members and several hundred staff located in four UTMB schools. We have 127 research projects and—funded by NIH—federal grants of more than $40 million. Our promise is to restore life, restore hope, and restore neural malfunction.

Our mission is to expand the frontiers of outstanding care for patients with neurological traumas or dysfunctions. The way to achieve that goal is through progressive research contributions, aggressive clinical trials, and accelerated development of new treatments. For that, of course, we need leveraged program funding. Without funds we cannot do too much to advance our knowledge and technology.

Why is it so important to focus on neurological recovery? I will give you several examples. One in every 1,000 people in the United States (mainly younger age groups) suffer from spinal cord injury due to car accidents. That healthcare cost is over $3 billion per year. Traumatic brain injuries also happen in 1 in every 1,000 people in United States (also mainly the younger age groups). That healthcare cost is over $10 billion per year.

Strokes are mainly in the older population. Every 53 seconds someone dies because of stroke. Another example is 1 of every 3 people over 60 years old is at risk of having a stroke attack. The healthcare cost is over $30 billion a year.

Our research and our goal is to make the wheelchair obsolete. We will do that by revolutionizing recovery through intellectual synergy, faculty recruitment, and fostering collaboration. At UTMB we have long history of good collaborations; everybody works with each other. We want to support new areas of research, including stem cell research. We have very good faculty and the facilities to train tomorrow's scientists and clinicians.

There's the old dogma that the central nervous system cannot regenerate. Shown here, are healthy nerve cells. If damaged, the old dogma says they cannot go back. But after decades of neural research and clinician practice, this is no longer true. We can actually help damaged nerve cells recover.

However, the best neural scientists in our school, in the world, cannot make dead cells alive again. So we use the stem cell as a source. Fortunately, the advances in stem cell technology really help us to get the stem cells working.

Our goal is to use stem cells to replace lost nerve cells, so they become healthy nerve cells and reconnect the wiring. Hopefully, not too far away, we will no longer have this old dogma. Our central nervous system can regenerate.

Along this line UTMB neural scientists have pioneered discoveries. This includes Dr. Claire Hulsebosch. Unfortunately, she's not here today. About a decade ago she led a group of scientists to isolate stem cells from human spinal cord.

They found that these cells were actually small floating cells. Previously, people threw the medium away, they were throwing the stem cells away. Now we find actual stem cells floating there. And these stem cells can differentiate and become nerve cells, both in culture dishes and in the spinal cord.

Dr. Hulsebosch also pioneered the process to engineer stem cells and let them express and deliver a lot of neuroprotective molecules. One is BDNF, one is serotonin. They found that when these stem cells are delivered to the surface of spinal cord, they can release BDNF and serotonin. The delivery of BDNF and serotonin can help improve motor and sensory function.

This is the work of Dr. Hulsebosch. She is Vice Chair and Professor in the Neuroscience and Cell Biology Department, director of UTMB's Spinal Cord Injury Program, and also director of Mission Connect, which is a Gulf Coast consortium consisting of five institutes, including TIRR, Baylor Medical College, UT Houston, and IBT Texas A&M, and UTMB.

She has led this group to be the first to find that nerve cells and nerve stem cells can grow in the culture; they can be grafted to the spinal cord and the brain to improve function and to also use that stem cell to be a mini-pump to deliver neuro-protective vectors.

Dr. Hulsebosch was the past president of the National Neural Trauma Society, which has over 270 manuscripts. Her three findings are actually now in Phase 1 clinical trials at UTMB, so it is really great to have her on campus. She is leading the Central Nervous System Injury Program and with a group of scientists working on recovery from spinal cord injury.

Dr. Donald Prough, who is professor and chairman of the Department of Anesthesiology, is a world-renowned scientist and clinician for traumatic brain injury. He leads a team studying how to help patients recover from traumatic brain injury.

Dr. Ronald Lindsey, as the chair of the Department of Orthopedic Surgery and Rehabilitation, leads a group of scientists in working on neurological recovery and rehabilitation.

We have very strong program on campus that is targeting drug addiction. Dr. Kathryn Cunningham, who is the professor and vice-chair of the Department of Pharmacology and Toxicology and director of the newly established Center for Drug Addiction, is working on the mechanism of cocaine and Ecstasy dependency.

We also have a world-class pain research team led by Dr. William Willis, who is the Green Distinguished Chair, professor, and past chairman of Department of Anatomy and Neuroscience, and also professor of Department of Physiology Biophysics. Dr. Willis's team focuses on the pain function and pain pathways and how to control pain.

In addition, we have many scientists working on the neurodegenerative diseases. Those diseases include Alzheimer's disease, Parkinson's disease, Huntington's, and spinocerebellar ataxia. Dr. Tetsuo Ashizawa is the professor and chairman of the Department of Neurology and leads both a strong research and a clinical practice toward these diseases.

Dr. Bernard Godley has recently been recruited as a professor and chair of the Department of Ophthalmology and Visual Sciences He is a world-renowned scientist in macular degeneration, ocular nutrition, and retinal health.

Recently we established at UTMB the George and Cynthia Mitchell Center for Alzheimer's Disease Research. Dr. Claudio Soto is the new director of the Center. We have a group of scientists working together to attack this disease, not only Alzheimer's but also Parkinson's disease, Lou Gehrig's disease, Huntington's, and mad cow disease. We are also currently recruiting new strong candidates as faculty for research and clinical practice.

Now I'm going to focus on my own research: human stem cells that repair damaged brain or spinal cord. First, I want to give you a brief introduction. I assume most of you or all of you are already very familiar with stem cells. Especially the political issues of stem cells.

There are three types of stem cells: embryonic stem cells, fetal stem cells and adult stem cells. Embryonic stem cells derive from one-week-old human embryos. At that stage there is a ball structure called blastocyst with an outer cell layer and the inner cell mass. The inner cell mass can be isolated and cultured. They can become any type of cell in the human body. Embryonic stem cells are the cells restricted by President Bush policy for federal funding.

Fetal stem cells are derived from discarded tissue of fetuses that are usually above eight-weeks-old. As adults, every tissue organ has a small number of stem cells. They're called adult stem cells, including bone marrow stem cells, umbilical blood stem cells, and they are also in your liver, fat, skin—you name it.

There are some differences in the percentage of cells being stem cell in the tissue. In the inner cell mass, 100% of cells are stem cells. That means every single cell can become any type of cells in the human body. Only 1–10% of fetal tissue have stem cell characteristics. I will come back later to tell you the characteristics of stem cells. Adult stem cell percentages are even lower. As cells become more differentiated to perform their functions, the stem cell population gets smaller and smaller. This makes difficulty for scientists to derive stem cells from adult tissue.

There are two characteristics of stem cell. The first one is called self-renewal, meaning that they can reproduce an exact copy of themselves. Embryonic stem cells have a self-renewal capability definitely. Fetal and adult stem cells have limited self-renewal capacity. Another characteristic is the multiple potential to become different type of cells. An embryonic stem cell is considered to have truly multiple potential, they're actually pluripotential. They can become any type of cells in the human body. Fetal stem cells and adult stem cells have restricted differentiation potential. They can become only certain types of cells in the body.

There is another characteristic of embryonic stem cells. They can form tumors, while fetal and adult stem cells have less likelihood to form tumors. So although the embryonic stem cells have the most incredible

potential to become any type of cell, they do have a tumor risk. And scientists have been working on that to reduce the formation of tumor.

There are two main challenges in stem cell research. The first one is how to grow the stem cell. Scientists can't do anything with a few thousand cells or a couple of hundred cells, it's just not enough. It is even more limiting in clinical studies. A couple of thousand cells won't be able to cure any disease. So the quantity of the cells is very critical.

So how to grow the stem cell? In our case we use a human fetal neural stem cell that's derived from a discarded human brain. It's shipped to us in a vial. This is about thousand cells.

It took us four years to come up with the best medium recipe to expand them. Like we need to eat food, these cells also need to eat their food. Their food is in this medium. The orange medium has amino acid, protein, carbohydrates, vitamins; everything they need. They also have growth factors. We find there is a combination of three growth factors that can make these cells grow. Otherwise they just stay there not growing and not replicating themselves.

So using this new medium we got the cells to grow from one cell into a ball structure of hundreds of cells in what we call a neural SPEAR. If you can see that line on the surface, that is indicating they're healthy, they're happy, they're growing. I have to shake them every day once a day. Otherwise they stop growing; they're on strike.

We can freeze the cells into vials and then store them in liquid nitrogen indefinitely. We can then recover them and expand them again. This allows us to have a lot of cells to work with. We don't have to always go back to original human tissue, but we have cells.

So the second challenge is how to make them become specific types of cells, in our case nerve cells, because human stem cells have the potential to become any type of cells. But for any disease we only lost one or two types of cells. We don't need all the other cells. We don't want to grow skin in our brain. Right? Nobody wants that.

So the question is how to get specific types of cells from these multipotential stem cells. This has come from our breakthrough discovery published in 2002. I developed a protein cocktail that can make this human neural stem cell become a specific type of nerve cells.

Basically we do is take that floating neural SPEAR and we culture it on the dishes, on the flat bottom surface. Then we add this priming cocktail, which has two proteins and one sugar molecule. This makes these cells become neurons, or nerve cells, and stained in red on the slide here. So those are the nerve cells.

Our discovery was published in *Nature*, and our story featured in the *Houston Chronicle*, reported by BBC News, Reuters Health, also in a story by Science Central, and aired on ABC network.

Now I want to give you some sense of how this translates to clinical patients. Our goal, of course, is to use human stem cells to replace lost nerve cells in the brain or spinal cord. I will use this, a diagram, to illustrate how we do it.

This is normal spinal cord, although our normal spinal cord is not that thick. Our spinal cord is about the thickness of finger. We have motor nerve cells, and then they send axons to control the muscle so we can move, we can talk, we can breathe. But under a diseased condition, in neural trauma, degeneration, or Lou Gehrig's disease, these motor neurons are gone. We want to use stem cells to replace the motor nerve cells and then reconnect to the muscle, so they can move again, and the patient can stand up.

I give you two examples here how we did this—how we studied the stem cell potential. The first one is called axotomy animal model. This is a baby rat, and we crushed the sciatic nerve that controls the legs and feet.

When this is crushed, it will cause motor neuron degeneration; the motor neurons die. Two months later we grafted a cell—our stem cell—into the spinal cord and into that left leg. Then we did a gait analysis and to check their behavior. One of the scientists put the hind limbs of this rat into the developer solution and then let the rats walk on the x-ray through this corridor. At the end we have a dark box. Since the rats like the dark place, they just walked there. You can see we get their footprints.

As you can see here on the right side, there's a normal footprint with their toes spread apart and their paws standing up. But with a sciatic nerve injury, their toes cannot spread. They clump together. They also have an elongated foot, they kind of drag their feet. This is before a transplantation.

Three months after transplantation, we found they had recovered pretty well, the same rats are very similar on the left side and right side. This is one example.

Another example is through collaboration with Dr. Prough in anesthesiology working with a traumatic brain injury model. This model is called Fluid Percussion Model. Basically, we have rats on the stage connected to a metal tube containing some liquids. At the end there is a piston and also a pendulum on the end. This pendulum can be placed at different heights. The drop of the pendulum strikes the piston and then transduces pressure to shoot the liquid into the skull and hit the brain. This is a very well established model to mimic trauma to brain injury.

Then we did a water maze analysis: one day after injury, we graft the stem cell into the brain, into the injured area. Then we close, let them wake up, and have run them on the water maze. What is this water maze? It's basically a four-feet-large swimming pool for rats. There is a hidden platform under the water that the rats cannot see. We drop the rats into the water. Although they are natural swimmers and swim very well, they hate the water. They circle the edge and try to get out, but find they cannot get out. So they're just swimming through the pool. Finally they hit the hidden platform and immediately get on top of it, escaping from the water. And we record the distance and the time.

Normal rats learn and memorize the location of this hidden platform. They know where it is, so after a couple of trials, the rats they will go to

the hidden platform immediately. However, if injured, they don't. With impaired memory, they cannot remember, so they still circle around and only by chance hit the platform. This slide shows the before transplantation and this is after transplantation.

At UTMB we work on cell expansion and cell priming to get stem cell growth and specific growth into specific type of nerve cells. Then we facilitate and collaborate, working on brain injury, spinal cord injury, stroke, Alzheimer's disease, Lou Gehrig's disease and even working on the mad cow disease. Our goal is to develop the technology to the point that it can enter clinical trials and can help to cure patients.

And for our future, I just want to mention this to you, under the leadership of Dr. Stobo, we have plans to expand UTMB. Right now this gray area is existing buildings for research and hospitals. In fifteen years we will double the square footage and have new buildings, shown in white. In particular, this building will be the building of neurological recovery. The idea is to have housed in the same building world-class scientists, students and also animals for a clinical trial laboratory, and then also the clinical patients and physicians. In this format we can facilitate the translation between bench top science to bedside clinics.

Our groups offer strength in basic science research, expertise in clinical application, collaboration and partnership, and a diverse team approach with clear goals and objectives topped off by leadership and vision. Thank you for your attention and for your being here. Now I will answer questions.

Discussion:

AUDIENCE: Two questions. One, were you affected by Hurricane Rita and how much of your lab did you have to shut down?

DR. WU: That's a good question. Actually the whole lab was shut down for one week. And then, of course, the cells didn't survive for one week without medium, so we had to discard those cells and then recover a new batch of cells. I said before that we can store the cells in liquid nitrogen, but because they are frozen, they are slowly recovered from liquid nitrogen storage. So my students actually suffered several weeks or even month to get back to our original schedule.

AUDIENCE: My other question is a scientific one. I follow you from where you say you can get the stem cell itself to become a neuron. But as you know, neurons themselves are specific; they're adrenergic, dopaminergic. So when you get the neurons, is it by position or location when you place them, for example, in a dopaminergic area? Which would be pertinent to Parkinson's disease versus somewhere else that's adrenergic? How do you get it to then program itself to say, I am a dopaminergic neuron?

DR. WU: Very good question. You probably did a lot of research on that. Yes, one critical issue I didn't have time to go into is that if we graft stem cells into adult brain, they usually remain undifferentiated or become glial supporting cells, and do not become specific type of nerve cells. So our finding of the primer was actually to get the stem cells to a certain stage that the cells can then acquire environmental cues, from where they are grafted, to become specific types of nerve cells there. For example, cholinergic neurons, GABAergic neurons, glutaminergic neurons, all according to where they are grafted.

AUDIENCE: I wonder is there any application for stem cells with mental illness, like schizophrenia? Has there been any work in that area or is that just a totally different application?

DR. WU: Yes. At this moment I'm not aware of anybody working on schizophrenia, but, in principle, if you have nerve cell loss, stem cells can play a role to replace lost nerve cells.

AUDIENCE: Has there been any application of this work on human beings, and, if not, what is going to have to take place before you will be able to go from the lab to the bedside?

DR. WU: Well, in the United States there is no clinical trial for injury or degenerative disease using stem cells. But recently a stem cell company in California gained FDA approval to use human neural stem cells for nervous system diseases due to the deficiency of enzymes in the brain. The clinical trial probably will start soon.

But outside of the United States, in Ukraine, in Peru and in China, there are several places that have already initiated stem cell transplantation into spinal cord injury patients or Lou Gehrig disease patients. So far we don't know what the outcome is and if there is any beneficial effect.

AUDIENCE: My question will show my ignorance about medical schools, because this looks to me like wonderful research that you're doing in this very important area of neurology and improvement of nerve cells. But is this usual in medical schools, that they will have projects of this sort for particular diseases or ailments? And, if so, do they specialize, as you have here, in this?

DR. WU: You mean, in the United States in medical schools?

AUDIENCE: Yes, the United States in particular, but internationally as well I should think. I'm well acquainted that cancer is under investigation. But does a medical school find some area that they think needs attention and then develop it as a specialization the way you seem to be doing here?

DR. STOBO: The answer generally is yes.

DR. WU: Yes.

DR. STOBO: In fact, one-half of the money that comes from the National Institutes of Health goes to medical schools to conduct research. Now, some schools have a deeper bench than others. We made a decision here in about 1998 that we didn't have unlimited resources, and we were going to take our scarce and precious resources and only put them into areas that represent its strengths, represent areas of high quality, and represented areas that served important society needs.

And I think you've seen the examples of that in terms of our emphasis in emerging infectious diseases and biodefense and neurologic recovery—and we've got some others. We don't have twelve, but we've got six that are among the best programs in the state or the country and, in the case of emerging infectious diseases, in the world.

AUDIENCE: Two questions. Are you doing any work on the neuropathies that occur with advanced diabetes? Number two: I'll give you a little anecdote here. I just had a tragic thing happen in my house. I had a parrot that I bought in 1963, an African gray, that knew 185 words in English and Spanish that were appropriate. He said good morning in the morning, good night at night. He had the name and could imitate the voices of all my six children. He died last week and we had a funeral after forty-seven years of life.

The question I'm asking in relation to this is that here is this parrot with a brain that's less than a gram in size that has all this capability. Now, admittedly, it was not "intelligent," but I've got mentally retarded kids who have 1,200 gram brains with no knowledge of their families' names, their siblings' names, have no speech. Why is it that a 1,200 gram brain that looks normal, weighs normal, has almost no function and this little tiny, tiny brain does?

Special projects ought to be set aside for special things that needed to be researched. In spite of the fact that a Ph.D. in a particular organization or school wanted their graduate students to do work in that particular field they ought to save a certain amount of dollars for these special kind of projects. And I wonder if that might be a special kind of project?

DR. WU: Well, I will answer the first question and let Dr. Stobo answer the second. The first question—the neuropathy—currently we're not working on neuropathy due to diabetes. But we have on campus a Dr. Randy Urban working on diabetes and trying to use human umbilical blood stem cells to replace pancreatic islet cells to try to find a way to cure diabetes. And that's the cause of the neuropathy. If we catch it early enough we'll be able to prevent a neuropathy from growing.

DR. STOBO: I'm sorry I didn't hear. Maybe after this presentation I can get with you and we can talk about that. Any other questions? Yes.

AUDIENCE: Dr. Wu, thank you for a fascinating presentation. You mentioned President Bush's federal restrictions, and I'm wondering if they've impacted your work at all.

DR. WU: Well, we are working with fetal stem cells, and those cells are not restricted, fortunately, by President Bush. So our work is currently not affected by the restriction. But in terms of the whole field, the stem cell field, it is. The United States are affected by President Bush's policy because there are limited cell lines that can be used, and also limited funds that can be used for stem cell research.

AUDIENCE: I have a second question. I know that you're a neuroscientist, but you are an expert in stem cell research. Perhaps you could comment on the recent reported successes in using stem cells to treat myocardial injury.

DR. WU: I think it's very fascinating—using stem cells to help to treat myopathy. I would like to see the long-term outcome at this point. A couple of years after the treatment will say something and will mean something. But what the long-term outcome is we still waiting to see. But it's very promising.

DR. STOBO: I want to thank you very much for a really exciting presentation and thank the audience for their attention and patience here at this program.

Discussion and Perorations

Harris L. Kempner Jr.
John D. Stobo

Mr. Kempner: What we thought we'd do is give Dr. Stobo a shot at all the questions and comments that you wanted to make and didn't have time to in the program. I have sat where you're sitting an awful lot of times and have always griped about the fact that there isn't enough time to talk or to hear from people. Jack's here as a resource, as the medical resource; the rest of us are here institutionally. I'm here to fade heat when they don't want to, but I'll manage this. It's wide open. If anybody wants to ask Jack any questions or make any statements now is the time.

Audience: Yesterday you spoke about the hurricane evacuation efforts. I know you have a large prison hospital on the campus. What were the logistics of that evacuation?

Dr. Stobo: Well, we do have a prison hospital on campus. In fact it's the only prison hospital associated with an academic health center and it's been here since the early 1980s. There's roughly 220 beds with about 80 to 85 percent occupancy, which is the normal occupancy rate for hospitals.

When it was clear that Rita was coming into the Gulf we started a process where we did not accept transfers from the outlying units to the hospital, so there weren't a lot of patients coming into the hospital. On Wednesday when we evacuated we probably had 50 patients in the hospital. Thirty of those went to Tyler and they were cared for in Tyler. I can't tell you where the other 20 went. Of course, there are issues that have to do with security, et cetera. So we were very fortunate and pleased that Tyler was able to take such a bolus of patients. Again, that went without any untoward event.

There is an interesting anecdote here. On Tuesday night we xeroxed the medical records of all the patients that were going to have to be transferred except for the prison population. And the reason we didn't do that is because we have an electronic medical record. So it was assumed that wherever they went there would be the ability on the other end to access the electronic medical record and that it would be electronically transferred. Well, Tyler isn't able to access electronic medical records. So those patients went to Tyler without much in the way of a medical record.

We had to xerox the medical records once we found that out and ship them to Tyler. It shows the importance of having universal electronic medical records.

MR. WRIGHT: Dr. Stobo, I'm Larry Wright from Austin. Thank you so much. We thought it was a really brilliant program that you put on for us. I was very impressed with the facility you have here, and what you're doing here is really interesting.

One of the things that occurred to me during the presentation at lunch about remote medicine is that one of fastest growing areas of medical practice on the internet is where people are treating themselves, basically a contract between the drug suppliers and the internet user. Instead of the illness or the symptoms, it starts with the drug. You click on the drug you want and you can get pretty much anything you want on the internet. It's completely circumvented the physician. There is a doctor I suppose on the other end, but he agrees to whatever you ask for. Typically it's Viagra or Prozac, but you've decided what you want. You can get Cipro, you can get Amantadine; you can get a lot of common drugs. And I notice on television an increasing number of ads for prescription medicines that are going to consumers that definitely are going to get it some other way than going to their doctor.

I was puzzling over how you get a medical professional into that loop, because that is probably going to be the largest growing area of medical practice. And I wondered, is there some way also of bringing pharmacists back into the medical world because now they've been sidelined.

DR. STOBO: Well, you're absolutely right. There is an easy solution. Part of it relates to what Ken and I were talking about yesterday in terms of this team of health professionals. The team would include a pharmacist. If you can get an informed consumer who can have easy access to a member of that team then that team, whether it be a pharmacist, a nurse practitioner, physician's assistant, or a physician, could participate in that decision making. It's going to require a lot of education on the part of individuals who are accessing health information through the internet, as well as a real attempt on the part of health professionals to make their expertise more easily accessible.

MS. KLEBERG: Sally Kleberg from San Antonio and New York. Yesterday there was one interesting question asked about the impact of women in the medical profession. And since the nurse's study first came into being and women are now seen more as different from men in the way they're treated. How much of that is impacting the way medical education is being presented in the classroom? I know that there's one doctor in New York at Columbia named Marianne Legato, who actually has a Center for Gender-Specific Medicine. Duke University Medical Center also has a Women's Health Initiative.

And it's speaking specifically to conditions like heart disease, osteoporosis, which both men and women have, but presents completely differently and should be treated completely differently. With more women coming into the medical field as MDs, are we going to see a ramp-up of this gender-specific medicine being taught broadly in the medical schools, not just in these isolated medical centers where there's been a push by the women in senior positions to get it done?

DR. STOBO: Well, the short answer is yes. But the bigger answer relates to what we were talking about yesterday in terms of having a healthcare workforce whose diversity reflects that in the population we are serving. For example, you can't understand the differences in the way diabetes affects Hispanics, Anglos, and African-Americans or men versus women, unless you have a workforce that reflects that diversity because they bring that interest to the educational and to the practice sphere.

So I think the emphasis on looking at different ways in which women present with myocardial infarction (heart attacks) for example, will occur more rapidly with the increase in the proportion of women in medical school, just like emphasis on the presentation of diabetes in Hispanics will increase if there's more Hispanics in medicine.

MS. KLEBERG: Why isn't it increasing even if there aren't Hispanics? We already have the women in the classroom, but somehow the way medical profession treats it is lagging.

DR. STOBO: Well, it is changing. And in the world of medicine it's probably quicker than it may seem. It's a cultural issue, but it is changing.

MR. MCCOWAN: I'm Scott McCowan, and I'm a new member. I just want to say it was a fabulous program. I have one comment. We didn't talk about the financing of healthcare. That wasn't an issue that we directly addressed. I'm head of a small group that does research and advocacy around access to healthcare. So I do just want to make the comment that while we didn't directly address it, there were a lot of pro-consumer, pro-market forces which I'm convinced, had we talked about it at length, those would not have proven to be the answer. We're creating a world, we're actually accelerating a world, where the haves have healthcare and the have-nots don't.

We really have to focus because that's going to be politically unsustainable. We have to focus on how we are going to provide healthcare. And, Doctor, you mentioned it was a matter of political will, which I agree with. But the second half of your sentence, and I don't actually think you meant this, was that we can't afford it. I think it is a matter of political will. I think we can afford it, and I think we need to begin to have a serious discussion in the nation about how we're going to afford it.

I just wanted to flag for the group that we really didn't tackle that

issue and that what little we said about it I didn't agree with and have an answer to. And so I just wanted to flag that for an ongoing discussion. But it was a fabulous program. Thank you very much.

MR. KEMPNER: Well, thank you very much for those comments. I agree with you. It is an issue of political will, and there is enough money in the system that could pay for increasing access. But somebody asked me afterwards what I thought was going to happen in terms of financing. And I'm afraid what's going to happen over at least the near term, unless there's some major cataclysmic event which changes this, is that we're just going to continue to see incremental change. This is what's happened over the past several years and it doesn't get at the issue that there are 46 million Americans in this country who can't get the healthcare they need and deserve simply and solely because they lack health insurance. And it's going up yearly.

MR. TAYLOR: Lonn Taylor from Fort Davis, Texas. This is really a follow-up to Scott's comment. Dr. Stobo, in your opinion what are the main causes for the rising cost of healthcare in this country? And what can we do about it?

DR. STOBO: The major cause is technology. As Ken said yesterday, probably 40 percent of the cost of healthcare and the rising cost of healthcare are the new technologies. As new scans come out, et cetera, they add a lot of money into the system. But associated with that is the fact the many Americans are willing to pay for it, irrespective of the cost. And it gets back to, again what we were talking about yesterday, the downside of employer-based health insurance where individuals who have health insurance don't know anything about the true cost of what they are accessing other than the co-payment or the deductible they may have to pay.

But if you just look at the numbers, technology is a major driver in terms of the cost. Then after that you have things like liability insurance, which is actually a pretty small part. Pharmaceuticals are about 15 cents of the healthcare dollar, but they have over the past two or three years been the portion of the healthcare dollar that has increased most rapidly.

Compare the cost in the United States to the cost of developed countries in the remaining part of the world and ask what the difference is. Our costs are greater than any other developed nation in the world. Is it because we have too many doctors, too many hospitals, folks stay in the hospitals longer? The answer is to all those is no. We have fewer doctors than many other countries. We have fewer nurses than many other countries. The length of hospital stay is the United States is less than it is for the average developed countries. But the cost per incident, per hospitalization, per hospital visit is higher than any other nation.

Now, there are places where we do lead the rest of the developed world. We have more MRIs than any other developed nation. We do more

renal dialysis than any other nation. Per capita we do more interventions in heart disease than any other nation. So it is technology and it is that the cost per incident or per hospital visit or per hospitalization that is a major driver. There are other things like liability insurance and pharmaceuticals, but they are down further in the list.

MR. KEMPNER: Just to remind you about pharmaceuticals, there has been an awful lot of attempts to import from Canada drugs because they're substantially cheaper. And the reason, of course, is that in Canada there's a single purchaser. It's their government and they are able to bargain prices in a way that no major healthcare plan can here. And these are the same drugs by competent manufacturers that they sell literally across the border at 30 and 40 percent less than they do here. That's true worldwide. It is, as Jack says, as far as anybody can tell, the fastest growing expense of them all. And it's taking a bigger and bigger piece of the total dollar. That's just one piece of it.

DR. STOBO: Let me just add to that, Shrub. If you look at the total amount of healthcare spending in the United States compared to other developed countries and look at the part of that that's represented by pharmaceutical costs, it's higher than any other developed nation in the world, just emphasizing what you were saying.

MR. KEMPNER: Same drug costs more.

MR. MARTIN: I'm Bob Martin from Corinth, Texas. Dr. Stobo in your presentation yesterday you touched on a number of demographic issues. But one that you just barely glanced through is the incredible increase in longevity of the population in the United States. There are a lot of projections, but the factoid that has hit home to me the hardest is that a female infant born in the United States today stands a 50 percent chance of living to be at least 100 years old.

We are witnessing a dramatic increase in the length of life, and projections for the 21st century are at least a 20-year increase over the length of the century. And that, in fact, with the results of genomics and other research could be quite a conservative estimate. Because of the increased healthcare needs of an aging population I wonder if you would comment on the long-term significance and impact of that on the general healthcare picture.

DR. STOBO: We are an aging society and the projection is by the year 2020 roughly 20 percent of the population will be 55 years of age and older. And that does have important implications in terms of healthcare professionals and costs. There will be more chronic diseases, for the cost does increase with that. So it is an important driver in terms of how we deliver healthcare and the cost of healthcare. And you're absolutely right about

the longevity. At the turn of the century the average longevity was roughly 43 years, and now it is just shy for the overall population of 80 years. So it has essentially doubled in a hundred years.

Now, if you look within that though there are tremendous disparities, again some related to differences in ethnicity, geographic location, et cetera. This came home to me when I was talking to the TIAA-CREF, which is the organization that provides retirement benefits for organizations like academic health centers. An individual said, Well, you know, when we look at the average age of longevity of individuals who are in TIAA-CREF it's 93 years old. Now, that's far longer than the average longevity in the United States. So there are portions of the United States population that have longevity that is far less than that. Again it's related to difference in equality with regard to access to healthcare, quality of healthcare, available to these populations, et cetera.

MRS. HERSHEY: Terese Hershey of Houston. I'm glad that some of us make it to 100. In the past civilizations, you know, the older women were the wisdom of the tribe. And if we can get through to 100 living with you guys, we're pretty smart.

I am a member of the National Recreation and Park Association, the Houston Parks Board, and the park people and all those things and former member of the Texas Parks and Wildlife. There hasn't been much on the program about preventive medicine. It's cheaper in the first place, and it's better for you. And I'm talking about walking, hiking, running, outside exercise. And Dr. Corona, who is the Surgeon General of the United States, spoke to that at RPA two years ago. And most of his talk was on the need for us to get up and get out and walk and do things.

What I wanted to call to your attention today is the deplorable state in the State of Texas of our parks. We have giving away parks. We've closed down four of them. Tomorrow night we will talk about taking away the 5,000-acre Lake Houston park and giving it to the city, which is willing to take it, because the Parks Department in the state of Texas can't afford to keep our parks open any more. And if you want real statistics you can talk to Andy. He probably doesn't want to talk about this having just being a brand new member. But this is a real problem. And I wanted to alert you all to it, because our own Legislature is not funding our own state Parks Department and we're giving away parks. We're closing parks. We're shutting parks down. And since 97 percent of the private land in Texas is privately owned, it's those parks where people that don't own their own ranches or living in a secluded neighborhood go. We don't build sidewalks any more. We have to go exercise and get out and do what the Surgeon General of the United States is telling us to do: walk and exercise before you get all these maladies that are so expensive to cure.

Incidentally, they have cut the park department program of helping cities. So there's no money coming into cities to help your parks. We used to get 50 percent of what came in. We don't now. Talk to your legislators.

SENATOR KRUEGER: Bob Krueger from New Braunfels, the only person from New Braunfels of our 40,000 members.

MR. KEMPNER: How the hell did you sneak in?

SENATOR KRUEGER: Before they knew where I lived. But I think that what our society has been very reluctant to address directly and what we haven't quite addressed directly here is that we take in this country education as being a given for all people. We take the attitude that if people in an emergency go to the emergency room they should get care whether they have money or not. If a person has a fire we don't say give us your credit card number before we send the fire truck. The fire truck is there.

Now, we have one in every six persons in this country who do not have health insurance. What we haven't, in my judgment, as a nation addressed is the question of is education an entitlement for all or is a fire truck an entitlement for all, but is healthcare an entitlement only to the five-sixths of the population that is more or less able to pay for it, but not to the rest of society. Our political figures, all of us have been reluctant to admit, that we are not really wanting to address the question of whether everyone should be entitled to healthcare.

And then if that is the case then how do we finance it. Let's not start with how do we finance more healthcare for more people, but let's approach it perhaps another way around. Is it something that everyone ought to have access to? And then if we take that attitude that it is I suspect that in America we can find the way.

MR. KEMPNER: I agree with that. Well said. Just as a matter of perspective I will recall 1992/1993 where exactly that attitude was taken and ran into a buzz saw of the most enormous proportions. And because what you eventually come down to I think when you take that stance is something approaching single payer. That's the elephant in the room that needs to be said when we have this discussion, at least in my opinion. And I'm not going to go into that, but it's part of the discussion that we had in the early days of the Clinton administration and it's been a third rail far more electric than social security in my opinion.

DR. STOBO: But the nation did it in 1965 when it said that it's unconscionable that we let the poor of a country not have access to healthcare and the elderly, because at that time the elderly were an important part of the poor of the country. Medicare and Medicaid were passed very quickly.

MR. KEMPNER: It's not to say it can't be done. It's just to say that's what we are talking about the implication of what Bob is saying and what Scott McCowan was saying

MR. PRADO: Ed Prado from San Antonio. Dr. Stobo, my question has to

do with the DNA research. I understand that with DNA they're finding out that not all medication works for everybody, that they can find out that something works for somebody and might not work for somebody else. For example, it might work with an Anglo but not African-American and vice versa. And that also they can find out through DNA that what diseases someone might be susceptible to that could result in preventive treatment knowing that this particular individual might catch a certain disease down the road and they can set up a diet or something to prevent that disease from occurring in that individual. What role or where does Texas stand with regard to DNA research?

Dr. Stobo: Well, you're absolutely right. Post the sequencing of a human genome, it has become clear that there are differences in the reaction to the side effects in terms of benefit, et cetera, to the same drug based on differences in ethnicity DNA makeup. So there's a lot of talk and effort now to do what's called customized medicine, that is to look at certain genomic sequences before an individual is put on a drug to understand the right dose, whether that's the right drug, et cetera.

So we're going to see a lot more of that. And it's going on in different places in the country. Duke University, their health system has a major effort in this area. To tell you the truth I'm not sure what's going on in the state of Texas, but I'm sure that there are institutions that are looking at this in the context of customizing medicine based on genomic sequences.

Mr. Prado: Well, with regard to preventive medicine I guess that's the same.

Dr. Stobo: Same thing. There's no doubt that preventing a disease makes a lot more sense than doing something to try to stem or intervene when somebody has a disease. That just makes good solid sense, and there are a lot of efforts going on prevention. The problem is that it's difficult to get somebody to support it. Health insurance companies won't pay for it because they don't see the immediate benefit of it. Prevention has in my view enormous positive consequences: 2, 5, 10, 15, 20 years after you start the preventive measure. And health insurers don't see that they would benefit from that. They take a short-term view of it and so are unwilling to pay for it.

Now, companies that have implemented preventive programs see enormous benefits in terms of productivity on their employees, lower health costs, et cetera. And I know at UTMB we started an intervention program called Commit to Fit for our employees about a year-and-a-half ago. And other institutions are starting to do the same.

And soon genomics will play an important part of that. Based on genomic sequence we think that it's possible that you could contract Disease X in the next 20 years. And we know that the Disease X is multifactorial: part is genomic, but also part of it is dependent on something in

the environment and that that can be prevented by doing this. And so that interplay will occur in the future.

AUDIENCE: Let me just say something about universal access. You know, a universal access does not have to be equivalent to single payer. There are different ways of financing healthcare in this country that don't require a single payer, particularly a single governmental payer, but can get at the same issue of universal access. I happen to think that a single payer is not acceptable to Americans and that there are other solutions which are more compatible with how we financed things in the past and more compatible with our entrepreneurial capitalistic approach.

DR. GUNTER: My name's Pete Gunter. I'm from Denton. These talks we heard yesterday were all excellent. And we've heard, but no one else will ever hear them. I make the suggestion that we think about videotaping the lectures, the talks that are given to this Society and then having a committee to decide which of these might be released for educational television or classroom use or something like that so that the really good stuff that happens here could get out to a further audience. And I'm not saying that we open the floor to people coming in, you know, that you get a big audience here. No, that's not it. But some of these things really should be preserved, and I think would be wonderful if they could be more broadly understood. So that's just a suggestion.

Secondly, I wanted to ask about this sort of alternative medicine going on today with acupuncture and herbal medicine and bathing in strange viscous liquids and I don't know what all. Is there really any push in the medical community to use more of this or is just a sort of verbal, well, we'll accept some of this though we don't like it.

DR. STOBO: No. The use of alternative and complementary medicine is a major force in medicine and increasing yearly. My own view on that is that there are important things that alternative and complementary medicine can add to medical care, as long as the use is based on evidence that the alternative and complementary medicine really works. And there are some areas that that clearly does have a beneficial effect. But there are areas in which evidence is lacking. And I wouldn't support using a type of alternative and complementary medicine where there wasn't scientific evidence available that, in fact, has a positive effect.

MR. KEMPNER: Jack, excuse me. You have a department at the UTMB, or at least a group, that works in it. Would you tell them a little bit about that?

DR. STOBO: Well, we have a grant from the NIH that is one of a handful of grants given to do research relative to alternative and complementary medicine, again, in the context of what I was saying, to develop evidence

that aromatherapy or acupuncture actually has a beneficial effect in whatever disease or disorder. Now, Shrub, one thing I do is ask Senator Zaffirini if she wants to makes some comments. She's given a lot of thought to healthcare. And I know she may have something to add to this discussion.

SENATOR ZAFFIRINI: Thank you so much. I'm Judith Zaffirini. I'm the State Senator from Laredo, District 21. In the Legislature I have often raised the question of who lives, who dies, who decides? We do. We make decisions about who lives and who dies. And, basically, we do that through funding. And the fact of the matter is that I have heard references to political will for funding, and the fact of the matter is that there are those who do not have the political will to fund healthcare at the appropriate level.

Years ago I heard a surgeon general talk about the six As of healthcare. She said that healthcare had to be accessible, accountable, adequate, affable, affordable, and available. Dr. Stobo, have we met those six As of healthcare? Affable perhaps in some areas, but certainly not everywhere. And this is what we worry about, that in Texas we have not done enough for healthcare.

Friends like Mrs. Hershey talk about the will of the Legislature. I have to tell you that there are some members of the Legislature who simply will not vote to fund the programs that we need adequately. You do need to talk to your Senators. You do need to talk to your Representatives. But you also need to talk to the members of Congress. There are so many issues that simply are not understood. For example, when we talk about Medicaid and we talk about CHIP we know how important these programs are to the people of Texas. Which is more important, Medicaid or CHIP? I say Medicaid.

Which is more popular? CHIP. Why? The Children's Health Insurance Program. It is easy to support a program that favors children. It is easy to sell a program that focuses on children. It's also realistically important to understand that treating children is less expensive than treating adults and that Medicaid is not only for children, but it's also for the elderly and for people with disabilities. So I say Medicaid is more important. But people don't understand the issues. And that is why I was so very, very pleased when I heard about the focus of this conference on healthcare. I do wish that we had focused more in the morning on stem cell research because so many of us were watching the game. But I was so grateful that you did focus on these issues. And I do hope that you will speak loudly and clearly about these very important issues.

I do have a question for Dr. Stobo, related to the one posed by Bob Krueger. Is healthcare a right or a privilege? Ladies and gentlemen, that is the dividing line in the Texas Legislature today, not only about healthcare but also about education. And in Texas we have decided that education is a right from the level of first grade, not kindergarten, first grade through twelfth grade. There are many of us who would like to extend that right to

higher education. We can't afford it. So is education a right or a privilege? And if it is a right at what level should it stop?

Is healthcare a right or a privilege? And if it is a right, to what extent? And that is my question. Thank you.

DR. STOBO: I happen to think that healthcare, universal access to healthcare, is a right, but that just starts the discussion.

SENATOR ZAFFIRINI: To what extent?

DR. SROBO: Yes, to what extent, who pays for it, what do you mean by right? Is that just a basic benefit package? Does a right mean that any American can access Viagra or any American can have a cosmetic surgery? Or does a right mean that any American can get access to basic healthcare, which is immunizations, et cetera? And if the answer is basic healthcare then what does that look like? In states that have tried, they start out with ten things that constitute a basic healthcare package. And then the interest groups get involved and it goes from 10 to 20 making it unaffordable.

MR. WHITTENBURG: George Whittenburg from Amarillo. I graduated from law school with Carlos Zaffirini, and I agree with everything Judith has said. The problem we face as optimistic Americans who have good will, who want to solve all the problems, is that there is a shortage of money. There's a cost to everything, and, consequently, you have to allocate scarce resources. I agree that the parks ought to be funded. But if funding the parks is the answer to exercise for Americans we're not going to do it because no one's going to get in a car and drive to a park for because parks are distant. It's got to be education to encourage everyone to exercise within two blocks of their home.

The problems of the baby boomers, I'm very concerned about whether our society, as strong as it is, and our economy, as strong and as good as it is, can pay the cost of two looming issues. One is healthcare and we're addressing it. But this is a very difficult problem. And we can address little pieces of it, but the overall issue is as the baby boomers move through their old age can we fund it? The cost of healthcare is soon going to be 17 percent of GDP.

I agree. Universal healthcare ought to be a right. But there are choices to be made. And we have two major things happening in this country. One is the baby boomers going through their old age and the healthcare for them. And the other thing is the war on terror. And we already have social security. And I applaud social security, and I support it. But it takes a certain percentage of the budget. And healthcare takes a certain percentage of the budget. And we may have just scratched the surface right now on the war on terror. We may be dealing with it not on our shores. But just as the avian flu can fly around the country you can have an attack in the United States.

I don't know whether this country's going to have enough money to solve all the problems. And so there have to be many difficult choices. I applaud this society for addressing it. I think that yesterday's program was excellent. It raised lots of thought-provoking issues. One thing I do want to point out. We live in a free market system. It's not perfect and there are many disadvantages, but it's what we've chosen and it seems to have worked pretty well. And I support it. But the reason preventative medicine is not supported by the insurance companies or anyone else is there's no money in it. If people don't get sick there's no money. And on universal healthcare what about the people who smoke? Can people make a decision to smoke and get lung cancer and absorb a large part of the dollars allocated for healthcare in this country? And that's an individual decision.

These are very difficult problems in a free society. And I don't think we're going to solve them all today, and we may never solve them all. But I think we've got to continue to struggle and address these issues.

DR. STOBO: Could I just add, in terms of having the money to do this, if we could decrease administrative costs associated with healthcare—if we could reduce errors, as Ken pointed out yesterday, that's going to take at a minimum millions, probably billions out of the system. If we could remove the duplication that many of you mentioned yesterday, where you go to one facility, have an MRI, go to another facility for the same disorder and they repeat the MRI for whatever reason, it's estimated that 20 percent of the cost of healthcare is due to unnecessary procedures and duplication of procedures. You add all that up and pretty soon you're talking about significant amounts of money, enough to address the issue of universal access.

So that's what I mean. There's money in the system, but it takes discipline. It takes more than a political will. It takes a moral will, particularly among health professionals themselves, which are the problem here in terms of cost. Don't forget, although doctors' compensation is roughly 20 cents on the healthcare dollar, what they add or what they order and what they tell patients adds up to be about 70 to 75 percent of the healthcare cost. Physicians play a very important role in this.

AUDIENCE: I'd like to ask you this. We often hear that 90 percent of the insurance money is for people who are in the last two years of their lives who have procedures like dialysis, which are extremely expensive, and the patient may have other illnesses as well in at late age. What about that?

DR. STOBO: Well, I forget the exact numbers, but they are roughly like that. Eighty or 90 percent of the cost occurs in the last several years of life. But it's also true that 80 percent of the healthcare costs go to 20 percent of the population. And that's true no matter what population the segment of the population get. Individuals with chronic diseases, for example diabetes and arthritis. Healthcare costs associated with that are enormous.

So the answer is, yes, that is true. We're used to having everything made available to an individual in terms of therapeutic interventions, et cetera. And that has to change. But it's not ingrained in medical education making those choices. When I went through medical school the framework of the education was you do everything you can for that individual patient. Now, that paradigm is shifting, particularly as we have to look at finding healthcare dollars to address the health needs of large populations. So how do you balance what's best for the individual patient versus what's best for 100,000 individuals?

When I came to UTMB I found that my patient was no longer the individual in the arthritis clinic, but an individual who doesn't receive the healthcare that they should to East Texas and along the Gulf Coast. Because our clinic extends far beyond Galveston Island— 120,000 inmates, 110,000 pregnant women below income who we treat in over 30 regional maternal and child health clinics all through East Texas, along the Gulf Coast, and even down into the Valley. And so how do you make decisions saying, now, what's in the best interest of those 110,000 women versus what's in the best interest of the patient who's sitting in front of me. And that's a different paradigm, and one we're moving into.

AUDIENCE: I feel very passionate about the fact that our system, although it's really great, has us in the middle, as I understood from the lectures yesterday, in the middle on providing healthcare worldwide, but toward the higher reaches of cost. And that's part of the free enterprise system. And it comes back to accountability at the point of sale—price resistance at the point of sale decisions. And whether it was by intention or whether it just worked out that way the insurance companies and the establishments have it in shape where no one knows what the cost is and there's no price resistance. And nobody realizes that they're the ones who ultimately pay. Some of the employers realize that we all ultimately have to pay.

But the other thing I want to address is Governor Lamm of Colorado several years ago took a lot of heat for saying: You know, sometimes the leaves just need to fall off the trees. We have a pluralistic society. Lots of us in this country are Christians and we want to go to heaven, but nobody wants to die.

MR. KEMPNER: It's really highly illogical, isn't it?

AUDIENCE: Now, there is a religious sect that is willing to die. And that's what makes this whole war on terrorism so ominous, is because this is a religion where people want to go to heaven, and they're ready to die—some of them. All of these issues come down to the fact that we as a society collectively have to do some triage and decide, as Judith Zaffirini says, who's going to live and who's going to die and who's going to decide.

Maybe the taxpayers through their elected representatives are the ones who have to decide. And that's where it's fought out and that's where it

should be fought out. I's a great system. I had a law partner who smoked for a long time. Got on an elevator in a no-smoking building. He just couldn't wait to fire up. He gets on, he fires up a cigarette, puts it behind him and looks the other way as a woman gets on the elevator. And she goes, Sir, are you smoking? Yes. Pulls the cigarette out. She says, Well, don't you know that's against the law? He says, Lady, I am the law.

Well, he is dead, and he made a decision and the last year of his life was not very pleasant. I'll bet you that the government and the insurance and the taxpayers and Medicare paid $500,000 in the last year of his life, which wasn't high quality. He was a Christian, but all of us loved him and he didn't want to die, and we kept hoping on hope that it would turn around and he wouldn't die. But those are the kinds of decision that we're facing.

My youngest of nine children is now out of college and has a job. They've all got jobs. My wife and I are healthy, and I love to be with her. But I want to say right now, I do not want to be kept alive at the expense of my children or the taxpayers. When my time comes I want to go. I don't smoke, I don't drink. Neither did my Dad and he got prostate cancer and died within a year. So you never know what's going to happen. But these are fundamental issues that everybody's got to face. And we are kidding ourselves if we go along with the insurance industry and decide that at all cost we're going to provide the ultimate in healthcare for every last one and extend some miserable years right at the end of someone's life at a huge cost to society.

MR. KEMPNER: You can rest assured that few people have as many witnesses as you do to your living will. Very few. Yes, ma'am.

MS. STUART: I'm Claudia Stuart from Amarillo, and I want equal time. I just wanted to say that when you look at healthcare and the people who are getting healthcare, delivery of services is very, very important. We know that there are physicians who don't want to go into some of our rural areas, who don't want to go into some of our inner-cities for their practices. As I looked at your demographic chart yesterday I noticed that in the upper Panhandle of Texas there's still some underserved areas out of the loop. How can we get those services to those areas? Do they have to be at the table for them to be recognized?

I live in an area where there's 4 percent African-American population. I'm at a number of tables, but I can't be everywhere. And just because I'm not there doesn't mean that I don't have to be considered. I still have needs that need to be considered by the people who are making some of the decisions all over the country. Look at delivery of services to low-income families; if we have a policy in this country of no child left behind in our schools why can't we start delivering services in healthcare to children in Head Start programs at school? You know, bring back the school nurse. Give her more importance and give her more duties. And also take care of our kids.

DR. STOBO: Well, I agree with what you're saying. But one of the problems is we're still operating in the old paradigm which says the only way you can provide healthcare is if you send a doctor to the rural areas. I would submit that we have to use a new paradigm. And we happen to think that telemedicine can be part of that paradigm. I think that other health professionals can be part of that paradigm. But we have to stop solving this problem or thinking of solving this problem in every case by having a doctor at the table. In other countries in the world other health professionals play a critical role in the health of the populations. And they provide healthcare to the entire countries.

MR. KEMPNER: Yes, I think it's important that everybody recognize, as I'm sure most of you did, that when you saw the telemedicine yesterday you always saw a paraprofessional or a nurse practitioner or even another doctor, but usually not, alongside the patient that was being seen by the machine and the doctor that's distant.

And that is certainly a mechanism by which some of this can be handled; clinics manned by those kinds of people and seen by doctors on a scheduled basis. But it's by no means the only answer. I happen to believe that you're absolutely right that delivery and the lack of same is a primary reason why you see some of the demographic differences in the way people survive these days.

MR. MCCOWAN: Scott McCowan from Austin. Just quickly on this question of what can we afford. I want to point out that as the state of Texas, in terms of state and local taxes, we rank 41st in the country in the percentage that we put into government. In other words, as a percentage of all of our income state and local taxes rank us 41st in the country. We are not making the kind of investment that our sister states are making.

And in terms of the federal government, at no time since the 1960s has the percentage of our total personal income that has gone into federal taxes been lower. We have had massive tax cuts in the last several years. So when we talk about what we can afford we need to look at what we're making and realize that, in fact, our tax effort is getting less and less.

And then one last comment on medicine share of the Gross Domestic Product. We also have to remember that medicine contributes to the Gross Domestic Product. One of the ways it contributes is in increased longevity, which means increased productivity, as well as the fact that it contributes as a business itself. So while its share of Gross Domestic Product may be rising Gross Domestic Product is also rising. And we have to remember medicine's contribution, and we have to look at bigger percentage but bigger pie. And of that pie we're putting less and less into both federal government and state and local government, which we could increase that effort and provide additional healthcare. And we have to look at that whole picture.

MR. KEMPNER: Just one observation. Even though tax rates on income are lower I'm quite confident that you'll find that the total amount of taxes

collected has risen rather substantially. So, obviously, there's a tradeoff in economic activity. Ithe subject of a totally other debate. But I when you say that we're paying less out of our current income, which is quite correct

MR. MCCOWAN: Not less in dollars, but less in percent.

MR. KEMPNER: Percent. But the dollars have increased overall quite substantially and against some people's projections. So it's dynamic and it changes. There's grades of opinion on both sides of that issue.

MR. POWELL: Boone Powell from San Antonio. There's something that we hinted at a little bit yesterday and we've talked about this morning and that is increasing longevity. But what we haven't talked so much about is increasing productivity and I think Scott just hinted at that.

I think that UTMB has a considerable program in wellness and increasing the quality of life. And I guess my question is do we see that as increasing the productive life of people in society? We've got the idea of retirement. Some people now think they ought to retire by 55 and so on. This has profound implications in a society where people are going to be living to 90 or 100 years old. I just want to throw that out.

DR. STOBO: Well, I agree with you, Boone. I think that as we increase longevity we do increase productivity. Part of living longer is living better. The advances of medicine are allowing that to happen.

MR. RANDALL: I'm Edward Randall from Houston. However, I was born on the Island. I want to compliment all those that have taken part in putting this session together. It's been very philosophical, as it was supposed to be. And listening to the differences of opinion in how to solve problems has been most interesting. Certainly we appreciate the medical profession in extending the lives of all of us so that we'll have more time to address the problems that will be created.

And it seems to me that to really address many of these things that we should have a benevolent dictator elected by a democracy. That's not likely to happen, but it's great that we're going to be around longer to work on these problems. And thank you very much for a wonderful session.

DR. KECK: Ray Keck from Laredo. I wasn't going to speak to this, but I just can't let it go. It's always the hale and hearty that say, Don't keep me alive, don't do this, I want to go when my time comes. I've just been living in Laredo with a situation, not in my own family, but one very close to me, that has preyed on me for the last several months because I haven't know what to make of it. And I'll just throw it out. I realize anecdotes are only anecdotes, but I saw this happen, and I'm sure everyone in this room has seen something similar.

A lady is 93 years old. She goes to vigil mass every single Saturday night and has gone for the last 75 years. She prays His will be done, Thy

will be done, every single night. Actually, she wants to thwart His will, as we all do and medicine does. We want to put it off. She needed a pacemaker a couple of years ago when she was 91. She can't walk, she can only watch T.V. She can't read. She can't even get herself in and out of the bed, but her mind is very, very clear.

Medicare paid $25,000 to install a pacemaker. She has eight children. Somebody might have said, You all just divide this up if you want your mother to have the pacemaker. But that's not the way the law works. And her children, two of them have said to me that they couldn't have afforded to do it, but they understand the dilemma. We all contributed. Now all she can do is watch T.V. and eat and sleep. But her mind is clear and she doesn't want to die. Who is going to confront her and say, I'm sorry. Senator Zaffirini's point of who will live and who will die and who will be the one to sit there and say, If you had $25,000 you could continue to eat and sleep and watch T.V. with a clear mind. Or you don't have the money? You're going to have to die.

It's a wrenching problem. Going back to what was suggested, I think what we all want is some kind of bureaucratic process that saves one human being from telling another human being that we can't pay for this. And no one has figured out how to do it. So my concern is even if the will were there for all the money imaginable I wonder if we would still not come back to the same question of do you really want this. And when a human being looks at you and says, Yes, I really want it, who's going to say you can't have it. It's a very, very difficult problem. I think only of those sitting here healthy, just having eaten a good breakfast, can breezily say, When my time comes please let me go. Of course you will when your times comes. But we'll also all of us work to postpone the time, and that's the human dilemma.

MR. KEMPNER: What you've also posed, as well as a social policy problem, is a medical ethics problem. And that's the one part that we did not have to get into sufficiently in this program because we were working on policy and cures or possible avenues of cure. It would have taken an entire meeting to really get into it because this discussion has been a medical ethics discussion if I've ever heard one about how to allocate resources, how to choose for an individual between life and death, and the inferential medical ethics problems of lack of delivery to certain parts of the population which we make as a medical ethics decision even unknowingly.

So we advisedly left it away because of exactly this. I was hoping that maybe we'd get into this kind of discussion this morning. But we advisedly let Ron Carson moderate instead of participate in the discussions. But keep in mind that that is the dimension you're talking about along with these others. And there are no easy answers to this, in my opinion at least.

MRS. TAYLOR: I'm Dedie Taylor from Fort Davis, Texas. Lonn and I moved to Fort Davis from Washington, D.C. three-and-a-half years ago.

In D.C. we had the best possible medical care. When Lon had a heart attack at G.W. the teamwork that you talked about yesterday really happened. Well, since getting to Fort Davis we've had a adventure of doctors, as it were. Lon has a chronic medical problem, and we ended up finding locally a fabulous internist after finding one other internist was overworked: he is the only person who delivers babies in three counties, and he's not an obstetrician.

I myself have had the recent experience of trying to find a gynecologist, which has been hell because there isn't one. Well there was one where we lived and he should have been disbarred or had his license taken away. He gave me very bad advice, and it's only because I'm intelligent that I didn't take his advice. Then I went to try to find a doctor in San Antonio. They forgot that I had made an appointment and their office was horrendous after making a seven-and-a-half hour drive. This is a very successful practice in San Antonio. I've now recently found one in Midland. But it's been an adventure that I wasn't planning on having. I'm very, very healthy, and I'm very intelligent, which helps a hell of a lot. So I can say no. But I had taken the advice of the one doctor I'd probably be dead or having a very bad reaction to drugs that shouldn't have been prescribed for me.

This is just by way of voicing the dilemma of some of us who live in extraordinarily rural areas. And the part of my preventive medicine is just the necessity to educate people. We had a boy in Fort Davis who died last year horribly at the age of 19 of mouth cancer because the stupid kid chewed tobacco. And the whole town gathered together for fundraisers for him and his family. But little macho boys are told, Well, you know, you're supposed to have a can in your back pocket. And it happens in front of us every single day.

I submit that part of the job of intelligent people is not necessarily go to the medical profession, but part of the job of intelligent people, such as myself in this instance, is to say to the little kid, Do you know it really isn't a very bright idea to do that? And sometimes they get defensive about it, but bit by bit it gets into them. So that it's not just about money. It's about using your own knowledge to say, Are you sure you really want to follow that doctor's advice. We have a friend who's doing all of these homeopathic things because she is definitely ill. But there's questions, Are you really sure you should be doing this in combination with that? And you don't have to be an M.D. to ask those questions.

MR. KEMPNER: We seem to have exhausted this subject, at least as far as this group is concerned for the moment. So it's now my pleasure to do one more chore. Roger, would you please come up? This is my last shining moment as your president. This is a gavel that Senator Zaffirini gave to the Society. It's a monster. You'll enjoy wielding it. But I'm here officially passing it over to you, Roger, so you can take charge of us for the next year.

Mr. S. Roger Horchow adjourned the meeting until December 1, 2006, in Dallas.

MEMORIALS

MARGUERITE JOHNSTON BARNES
1917–2005

Marguerite Johnston was exceptional even in the Golden Age of American Journalism. Her mastery of English was incomparable, and her integrity beyond question.

She was born in Birmingham, Alabama, descended from three generations of college graduates. After earning a Phi Beta Kappa degree from Birmingham-Southern College, she began her career as a reporter for the *Birmingham News*. She asked for and received the assignment of Washington correspondent for the last year of World War II. In 1946, she married Charles Wynn Barnes, a returning Navy veteran, whose profession as a petroleum geologist brought them to Houston.

When women were encouraged to stay at home, she raised four children while writing full time for the *Houston Post*. During forty years at the *Post,* she covered the organization of the United Nations and the founding of the Texas Medical Center, converted the women's section to a lifestyle section, wrote a popular daily op-ed column, reviewed mysteries, wrote Mrs. Hobby's speeches as well as her own, published feature articles, and ended as Assistant Editor of the Editorial Page. Her coverage of foreign affairs, alcoholism as a disease, and population control won her many awards. The excellence and prolificacy of her writing will never be matched.

Her research for *A Happy Worldly Abode*, a history of Christ Church Cathedral, the oldest church in Houston awakened her interest in early Houston and Texas history.

Her brilliance and cheerfulness drew many people, among them Houstonians with achievements of national significance. She used their achievements as the theme for her book, *Houston the Unknown City*. She was immensely proud of the city that had welcomed her warmly as a bride, of its philanthropy, the gentility of its early history, its international heritage, and its tolerance.

Throughout her life, she radiated goodness, faith in her fellow creatures, and gratitude for a blessed life. She met pain in her later years with courage to spare her family distress. She was revered and beloved by many who will always miss her.

—Pat Barnes Ricks

John L. Margrave
1924–2003

John L. Margrave, E. D. Butcher Professor of Chemistry at Rice University, died December 18, 2003 after a brilliant career that spanned five decades. Dr. Margrave made a multitude of professional and personal contributions across diverse settings, exemplifying his commitment to scientific excellence and the larger community. He loved teaching and interacting with students of all ages, and his inspiration brought many students to the study of chemistry. He was recently honored by the American Institute of Chemists with the Chemical Pioneer Award for his groundbreaking research in the field of fluorine chemistry and for his work with high-temperature liquid metals. In July 2003, he and his research group received a third R & D 100 Award for his innovative work on fluorinating carbon nanotubes. His research, including more than 800 scientific publications, consistently expanded the frontiers of chemistry. He was elected to membership in the National Academy of Sciences in 1974. He was also elected as fellow of the American Institute of Chemists, the American Physical Society, and the American Association for the Advancement of Science.

Dr. Margrave and his research group often presented chemical magic shows for youth in libraries, schools, and the Houston Museum of Natural Science. He mentored more than 100 graduate students and 100 postdoctoral researchers during his career. Interacting with his students and sharing in their success and interests provided deep satisfaction in his professional life. For many years, Dr. and Mrs. Margrave have been Faculty Associates at Rice's Graduate House.

A graduate of Rosedale High School in Kansas City, Kansas, he achieved the honor of Eagle Scout as well as induction into the Mic-O-Say order of scouting. Dr. Margrave received his B.S. and Ph.D. degrees from the University of Kansas, Lawrence, where he was a Summerfield Scholar and a Slosson Graduate Fellow. He was named a Distinguished Alumnus of the University of Kansas in 1981. He pursued postdoctoral work at the University of California, Berkeley, where he received an Atomic Energy Commission Fellowship. In 1952, he joined the faculty at the University of Wisconsin, where he was an Alfred P. Sloan Fellow, a Guggenheim Research Fellow, and a recipient of the Kiekhofer Memorial Teaching Award.

In 1963, he joined the faculty at Rice University. During his tenure, he received dozens of the highest awards and honors in his field. He served in the U.S. Army in World War II and as a Chemical Corps reservist. In recent years he was the Navy ROTC representative for Rice.

Dr. Margrave served as Chair of the Rice University Department of Chemistry from 1967–1972, as Rice's Dean of Advanced Studies and Research from 1971–1980, and as Vice President for Advanced Studies and Research from 1980–1986. As a member of the National Acad-

emy of Sciences, Dr. Margrave served on key committees of the National Research Council related to nuclear safety, armaments, and demilitarization of chemical weapons. He was President and then Director of Sigma Xi from 1986–1992.

Dr. Margrave was born April 13, 1924, in Kansas City, Kansas to Orville F. and Bernice June Hamilton Margrave. He is survived by his wife of 53 years, Mary Lou Davis Margrave; two children, David Margrave and his wife, Allison; and Karen Margrave Bornhofen and her husband, R.J.; and five grandchildren.

—David Margrave

George C. McGhee
1912–2005

There are, of course, many men and women who have made major contributions to geophysical exploration for hydrocarbons and the oil industry. But it is doubtful that any have contributed so significantly over such a wide range—from pinpointing the location of a wildcat to delicate diplomacy among nations and major companies in different hemispheres (which would determine the course of the entire industry and the flow of astronomical amounts of money)—as George McGhee.

McGhee spent less than a decade of his professional life as a full-time exploration geophysicist, but that was sufficient to make a distinct impact. He worked as a subsurface geologist while a college student, which caused him to pick exploration as his profession. Following graduation from the University of Oklahoma (as a Phi Beta Kappa) in 1933, he joined Conoco's geophysical staff. He was a computer on the crew which made Conoco's first discovery in the Gulf Coast via reflection seismology. He also developed, in collaboration with the late E. V. McCullom, original ideas for estimating weathering corrections, ideas the company deemed of sufficient import to patent. He left Conoco to accept a Rhodes Scholarship at Oxford, where in 1937 he earned a doctorate in physical sciences based on the first seismic reflections obtained in England. After returning to the US, he became vice-president of National Geophysical Company, conducting the first reflection seismic survey in Cuba. He left National in 1940 to become a partner in the celebrated consulting firm of DeGolyer and MacNaughton, to which was added "McGhee."

McGhee served in the US Navy during World War II and, after earning the Legion of Merit and three battle stars, launched a new career in the diplomatic service. His success was virtually instantaneous and he spent nearly all of the next 25 years in a succession of key positions including coordinator for aid to Greece and Turkey—our first Cold War effort to contain Communism; ambassador to Turkey (1951–53); Under Secretary of State for Political Affairs (1961–63), and ambassador to West Germany (1963–68).

This second career was not completely divorced from geophysics and the oil industry. The US Government regularly took advantage of McGhee's expertise during the periodic "crises" which occurred. The most important such incident happened in late 1950 when McGhee, then Assistant Secretary of State for Near Eastern Affairs, brokered the complex "50-50" negotiations between Aramco and Saudi Arabia. The final agreement, which in pure cash terms must rank with the biggest business deals in history, was agreed to by the Aramco parents in his office.

Despite his distinguished diplomatic career after World War II, McGhee never lost interest in geophysics nor ever completely left the oil business. He has operated, with an enviable record of success, as an independent oil explorer/producer since 1940, having explored seismically 70 areas, leading to 34 wildcats which resulted in 13 oil fields. He still lists McGhee Production Company as his professional affiliation on SEG's membership roster. He also served as a director of Mobil Oil Company and Mobil Corporation from 1969 to 1982, as well as 11 other boards, and was chairman of Saturday Review.

Incredibly, McGhee has at least two other careers that are worthy of significant mention—heavy involvement in civic affairs (locally, nationally, and internationally) and as a writer.

The list of respected organizations which McGhee has assisted or served in a leadership capacity covers the better part of two typed pages. They include the chairmanship of the English Speaking Union, the Smithsonian National Associates, the National Academy of Sciences Advisory Committee to HUD, and membership in the President's Circle of the National Academy of Science. He served on four university boards and received four honorary degrees.

McGhee's writings are similarly diverse. He has published articles in peer-review scientific journals as well as in Foreign Affairs, the Washington Post, the New York Times, US News and World Report, and Reader's Digest. He has also been the author, editor, or co-author of at least eight books. One of these, the 1989 novel *Dance of the Billions*, is an extremely realistic and informed treatment of the oil industry—ranging from sophisticated seismic exploration to executive suite maneuvering to complex litigation—during the boom of the '70s. This book merits much wider readership than it has received.

SEG created the Special Commendation Award to recognize meritorious services to the public, the scientific community, or to the profession; and these services may have been performed via community leadership, professional leadership, or even outside the mainstream of geophysics. The biggest problem in giving this honor to George McGhee was to decide under which category to award it. He was qualified, supremely so, in every one! I suspect the creators of this award never imagined that a recipient would put the Society in such a dilemma.

—Dean Clark

D.J. Sibley
1913–2005

D.J. Sibley was born March 5, 1913 in Bertram, Texas and grew up in West Texas. His family pursued ranching and business interests in Fort Stockton. D.J. received his BA from UT Austin and his M.D. from the UT Medical School in Galveston in 1937. D.J. left his residency to serve in the US Medical Corp, from 1940 – 1948. He fought in ten major encounters and was in command of the medical forces for the retaking of Corregidor north through Luzon, Keyte and Milne Bay in the Philippines.

In 1950, at the age of 37, D.J. married Jane Dunn Sibley. He practiced medicine and ranched until 1961. During this time, D.J. persuaded the bishop of the Rio Grande to let him start a mission in Fort Stockton, where he acted as lay reader. A gift of a tiny, historical Victorian one room church from Pecos that was rescued from the wreaking ball and moved by D.J. and Jane to Fort Stockton later became St. Stephen's Episcopal Church. Together, they founded the Fort Stockton Historical Society, leaving the city a permanent gift of the Old Fort Parade ground, and their home, which was adjacent to it.

In 1962, D.J., Jane and their three children, Jake, Mahala and Hirum, moved to Austin, where he nourished his interest in ecology, range management, plant biology and genetic programming while engaging in scientific research at the UT Clayton Foundation Biochemical Institute in Austin. In 1982, he established the D.J. Sibley Centennial Professorship in Plant Molecular Genetics, the first endowed support for plant research at UT Austin. His other interests were music, ballet, art history, genealogy and philanthropy. His lifelong passion for languages centered upon Spanish, but included Latin, German, Creek and Pidgin English. He was an active participant in the Austin Symphony, was keenly interested in the archeology of Texas and was a founding member of the Texas Rock Art Society, Bat Conservation International, the Chihuahuan Desert Research Institute, Environic Foundation International, and the Big Bend Studies Program at Sul Ross State University in Alpine.

D.J. died at age 91 on January 8, 2005.

—P.H.

Charles Cameron Sprague
1916–2005

Charles Cameron Sprague, M.D., the first president of The University of Texas Southwestern Medical Center at Dallas, died on September 17, 2005, in Dallas, at the age of 88.

Charlie joined UT Southwestern in 1967 to assume what was then the institution's top administrative position, that of dean of Southwestern Medical School. Five years later, upon the school's reorganization as a

comprehensive academic medical center with three distinct schools (medical, graduate biomedical sciences and allied health sciences), he became the institution's first president, serving in that capacity for 14 more years. Along the way, he became a dedicated member of the Philosophical Society of Texas, which elected him as its president in 1996.

Charlie was born in Dallas and had deep roots in the city, his father having been the city's mayor from 1937–1939. His upbringing was grounded in devotion to community, church, and service — influences that stayed with him throughout his life. He went to public schools in the Oak Cliff area of Dallas, where he excelled as an athlete and scholar, and then enrolled at Southern Methodist University. Originally an accounting major, he whizzed through his classes effortlessly, spending much of his time as an all-conference football and basketball player and captain of both teams.

Dr. Sprague had no interest in being a doctor until he injured a knee during his junior year at SMU, after which he became fascinated with the process of healing. Too late to change majors, he added a fifth year of college to complete pre-med requirements and graduated with bachelors' degrees in both science and business administration from SMU in 1940. A medical degree from the UT Medical Branch in Galveston followed, as well as a stint in the Navy and service in the South Pacific.

Charlie went to New Orleans in 1947 as an internal medicine resident at Charity Hospital and the next year he was appointed to the staff of Tulane University School of Medicine, where he was selected to establish a division of hematology. Soon after, he was awarded a hematology fellowship at Washington University in St. Louis and then one at Oxford University School of Medicine in England. He returned to Tulane as assistant professor and director of the hematology laboratory, was promoted to associate professor in 1954, became a full professor in 1962, and was appointed dean of the medical school the following year.

It was not to be at Tulane that Dr. Sprague's vision for the future would be fulfilled, however. A few years into his tenure, his plan for the construction of a new medical school campus and university hospital was rejected by the Tulane governing board as "too risky," leading him to be receptive to overtures from more far-sighted institutions.

In 1967, the ideal opportunity presented itself. UT Southwestern faculty members and Dallas community leaders were ready to launch a major upgrade of the medical school, and they recognized in Sprague the best possible leader for the effort.

Charlie returned to Dallas to lead an institution confronted with three pressing and somewhat divergent needs. For the school to flourish, it would have to grow substantially; major advances in basic sciences and research would be required; and, at the same time, formidable clinical issues arising from service commitments to the Dallas community and to Parkland Memorial Hospital would have to be addressed.

Charlie championed this triple development with courage and imagina-

tion. He persuaded the UT Board of Regents to support the creation of a life sciences center that brought together researchers and clinicians, and established a collaborative culture that set the school apart from other institutions and positioned it for greater breakthroughs. In addition, he pushed Dallas County commissioners and local citizens to support an $80 million bond package (the largest in Dallas's history at the time) to bring Parkland up to the standards that would enable it to provide first-rate care to its patients and help attract top-flight faculty and students to the campus. His vision and his ability to build consensus guided UT Southwestern toward greatness as one of the leading medical schools in the nation.

After serving as dean and then president at UT Southwestern for 19 years, Charlie retired to become chairman of Southwestern Medical Foundation, a position he left in 1997 at age 80.

When Charlie arrived at UT Southwestern, the medical center consisted of three small academic buildings attached to Parkland Hospital. Filing cabinets and scientific equipment lined hallways and full-time professors squeezed into broom-closet-sized offices.

He initiated a $40 million building expansion, unprecedented at the time in Dallas; doubled medical school enrollment within 10 years; and expanded allied health and research training programs. Attention to recruiting world-class scientists and physicians to UT Southwestern was a crucial part of his plan, and many of the world's brightest minds traveled to Dallas to join UT Southwestern's ranks, lured by an atmosphere of community spirit and an institutional ambition for excellence.

In 1979, one of Sprague's initial recruits, biochemistry chairman Ronald Estabrook, became the first person elected to the National Academy of Sciences from a Texas medical institution. In 1985, two months after Charlie had announced his plans to retire, UT Southwestern faculty members Michael Brown and Joseph Goldstein won the Nobel Prize, the first ever awarded to Texas researchers — a fitting culmination of Charlie's two decades of leadership.

While taking UT Southwestern to new heights, Dr. Sprague earned the respect and admiration of thousands of friends and colleagues locally and nationally. He was an early member of the prestigious Institute of Medicine, and was elected president of the Association of American Medical Colleges. He played major roles in scores of community task forces, service organizations and church groups. The Charles Cameron Sprague Distinguished Chair in Biomedical Science, the Charles Cameron Sprague, M.D., Chair in Medical Science and the Charles Cameron Sprague, M.D., Chair in Clinical Oncology were endowed at UT Southwestern in his honor in 1982, 1998 and 2005. A new facility at UT Southwestern, the Charles Cameron Sprague Clinical Science Building, was named for him in 1989.

Charlie was preceded in death by his first wife, Margaret, and his second wife JoAnn. He is survived by his third wife, Alayne; his daughter,

Cynthia Cameron Sprague Hardesty, and her husband Steven of Plano; and his grandchildren, Cameron Elizabeth Hardesty and Michael Sprague Hardesty. Other survivors include four stepdaughters and seven stepgrandchildren.

Charlie was gregarious, with a booming cheerful voice and an engaging smile. Large of stature and personality, he nevertheless was the opposite of intimidating. People of all levels flocked to him, liked him, and relied on him.

UT Southwestern, Dallas, and Texas were extraordinarily fortunate that Charlie agreed to become the medical school's leader in 1967. He had an instinctive vision of what was required to move the institution to greatness and an ability to persuade everyone he dealt with of the importance and value of his goals. He was the classic example of the right man for the right job at the right time.

Charlie Sprague's integrity and trustworthiness were absolute. He inspired and enriched the lives of all who had the privilege of working with him and learning from him. He was a giant in medicine and a wonderful human being.

—K. W.

Robert S. Trotti
1917–2005

Robert Swift Trotti was born in Brookland, Texas on February 11, 1917, the son of Benjamin Trotti and Alice Perol Trotti. On December 13, 2005, he passed away in Dallas. Known to his many friends as Bob, he moved to Port Arthur in 1937.

Volunteering for military service in 1941 as an Army Private, he later served as an Infantry Captain in the United States Third Army in Europe, participating in five major campaigns and receiving two decorations. During the war, Trotti served under General Patton as a Chief of Staff in the 36th Infantry Division. Upon his discharge in 1946, he stayed in the Reserves and became at Lt. Colonel, General Staff Corps 36th Infantry Division.

After the military service Bob attended college at Stephen F. Austin in Nacogdoches. He later moved to Austin, where he graduated from the University of Texas in 1950 with BBA and LLB degrees.

After becoming a member of the State Bar Committee of Texas in 1951, he re-wrote the Business Corporation Act that was passed in 1955 by the State Legislature. Appointed First Assistant Attorney General in January 1953, Bob served for three years in that capacity under Attorney General John Ben Shepperd. Subsequently, he served as Chief of the Corporate Charter Division of the Department of State, was a member of the Administrative Law Committee of the State Bar Association, the American Bar Association, the Texas Bar Association, Travis County Bar Association, and the Dallas Bar Association.

Bob was one of the founders of the Headliners Club, the most prominent club in Austin. For the last 55 years, all Texas Governors, including Preston Smith, Allan Shivers, John Connally and William Clements have been members of the Headliners Club. Bob was a friend of all of these governors.

After leaving public office, he moved to Dallas, where he became associated with Bill Blakely's law firm. Bob was a shareholder in the law firm that would become Ray, Trotti, Hemphill, Finfrock and Needham. He is survived by his wife of sixty years, Edna Grace Trotti.

—J.S.W.

Frank Everson Vandiver
1925–2005

Frank Everson Vandiver, Civil War and WWI historian, university administrator and president, and former President of the Philosophical Society of Texas, died at his home in College Station from heart and lung complications on January 7, 2005.

Vandiver was born December 9th, 1925, in Austin, Texas, the only child of Harry Shulz Vandiver and Maude Everson Vandiver. A gifted student possessed of a restless intellect, Frank Vandiver's education and early career were by today's standards unconventional. He published his first academic paper at 16, earned his BA at the University of Texas by examination, and won his MA at Texas in nine months and his PhD at Tulane in two years. He described his childhood as that of a "faculty brat." His father, a Pennsylvania native, spent forty-two years in the mathematics department at the University of Texas. A leading authority on number theory, Harry Vandiver (1882–1973) was among the first mathematicians to extensively use computers to study Fermat's last theorem. Like his son, he was something of a prodigy whose education did not fit the standard academic pattern. Antagonistic toward public education, he left school at an early age to take a post in his father's firm. In 1900, at the age of 19, he began publishing a series of notes and problems in the *American Mathematical Monthly*. This led to collaboration with George David Birkhoff (1884–1944), and in 1904 they jointly published an article in the *Annals of Mathematics* (second series, 5:173–180) that introduced what is still known today in number theory as the "Birkhoff-Vandiver Theorem." He won the prestigious Cole Prize from the American Mathematical Society in 1931 and was named Distinguished Professor of Mathematics and Astronomy at Texas in 1947. In addition to the post at Texas, Harry also taught and worked at Cornell, Chicago, Indiana, Notre Dame, and Princeton, where, as Frank was fond of recalling, the family lived next door to Albert Einstein. Harry and Maude never owned a house, living instead in the Alamo Hotel where he kept a large collection of classical recordings.

Frank Vandiver began his scholarly career with a United States Civil Service appointment as Historian at the Army Service Forces Depot in San

Antonio, Texas (1944–1945). He was a Rockefeller Fellow in the Humanities and in American Studies from 1946 to 1948 at the University of Texas, where as mentioned above he earned his BA by examination and, in 1949, his MA. While pursuing his PhD at Tulane, he worked as a teaching assistant. After his PhD he served for one year as Air Force Historian in Montgomery, Alabama, and then went on to Washington University in St. Louis in 1952 as an Instructor and the next year was promoted to Assistant Professor. In 1955 he won a Guggenheim Fellowship and moved to Rice University. In 1956 he was promoted from Assistant to Associate Professor and then Full Professor in 1958. Except for visiting appointments at West Point and Oxford University, he would remain at Rice until 1979, rising through the ranks to become chairman of the Department of History and Political Science (1962), chairman of the Department of History (1968–69), Acting President (1969–70), Provost (1970–79), and Provost and Vice President (1975–79). He also held the Harris Masterson, Jr. Professorship at Rice, served as the Master of Margarett Root Brown College, and was the Harmsworth Professor of American History during his visiting appointment at Oxford.

During his time at Rice he began life-long associations with many professional and learned organizations, including the Southern Historical Association, of which he was Vice President and President; the American Historical Association; the Society of American Historians, of which he became a Fellow and served as Councilor and on the Board of Directors; the Jefferson Davis Association, of which he was President; the Bicentennial Commission of Texas, of which he was Executive Director; the Texas State History Association, of which he was a Fellow; the United States Commission on Military History, of which he served on the Board of Trustees; the National Council on the Humanities, of which he was chairman of the education sub-committee and chaired numerous other committees; the P.E.N. American Center; and many more organizations. He was also a member of the Philosophical Society of Texas, of which he was President (1977–78); Phi Beta Kappa; and the Cosmos Club. He also served on the Editorial Board of *The Papers of Jefferson Davis*, of which he was Chief Advisory Editor, and *The Papers of U. S. Grant*. His many awards and distinctions in addition to the aforementioned Rockefeller and Guggenheim Fellowships included the Carr P. Collins Prize from the Texas Institute of Letters, the Harry S. Truman Award from the Kansas City Civil War Round Table, the Outstanding Civilian Service Medal from the Department of the Army, the Outstanding Graduate Alumnus Award from Tulane University, an honorary MA from Oxford University, and an honorary Doctorate of Humanities from Austin College.

In 1979, Vandiver was named President of North Texas State University (now the University of North Texas). Though his selection was enthusiastically received by the NTSU community, relations with the faculty were soon strained. At issue was his proposal to re-organize the faculty and the curriculum. Instead of a traditional academic organization built around

colleges and departments, Vandiver proposed a system built around interdisciplinary "learning centers" in an effort to make NTSU more competitive among its peers and distinct among other institutions in the region. He hoped the plan would also boost research funding. The proposal met immediate resistance and, though he still enjoyed the overwhelming support of the NTSU regents, when the offer to assume the presidency of Texas A&M University was extended 18 months into his administration, he had no hesitancy in taking the job. Despite the turbulence during his time at NTSU, friend and foe regarded him as an innovative and visionary leader. Winfred Brown, chairman of the NTSU regents, credited him with turning the "whole university around" and breathing "life into it."

He was appointed president of Texas A&M in 1981, and although his tenure there was much longer and smoother it was not without rough patches. Early in his administration the Board of Regents fired and replaced the football coach without his approval. He felt the move "irreparably damaged" the presidency and offered to resign. He withdrew that offer only after the regents agreed to involve him more closely in future decisions of such magnitude. Another serious challenge occurred in 1984, when a member of the Corps of Cadets died as a result of a hazing incident. He took swift action to further reinforce the University's prohibition on such activities. The other major challenge of Vandiver's administration occurred in 1986 when the legislature slashed the A&M budget along with that of all other public institutions. After a year of intense lobbying, the budget was restored to nearly the same level as in 1985.

Vandiver's successes far outweighed the challenges of his term, however. The first Faculty Senate at Texas A&M was elected on his watch in 1983. In that same year, enrollment exceeded 36,000. Research funding surpassed $100 million and would reach $176 million by the end of his tenure. The university's endowment passed the $1 billion mark. By the time he stepped down in 1988, A&M was among the top 10 universities in the country in recruiting National Merit Scholars. Despite the fact that he disagreed with the process that led to the hiring of Jackie Sherrill in 1982, the football team enjoyed a remarkable period of success during his tenure and Vandiver counted himself among the team's biggest fans. A&M also reached a new level in faculty recruitment, wooing two Nobel laureates, a Pulitzer Prize winner, and several members of the national academies of sciences and engineering to its ranks. He also worked to create joint study and research programs with foreign universities and to open more opportunities for study abroad for A&M students. Perhaps his most lasting achievement was in instigating the space-grant program, which he proposed to Senator Lloyd Benson. The program was implemented by NASA and A&M added "space grant" status to its "land" and "sea grant" designations. Today A&M is one of only a few universities to enjoy this triple distinction.

Vandiver was first and foremost a historian, however. His involvement in the Jefferson Davis papers, the U. S. Grant papers, and numerous

scholarly organizations have already been mentioned. A specialist in the confederacy and the Civil War, he edited and authored over 20 books and wrote numerous articles in scholarly journals as well as over 100 reviews in many national newspapers, including the *New York Times*, the *New York Herald Tribune*, and the *Saturday Review of Literature*. He was also a highly regarded historian of WWI. His book, *Black Jack: The Life and Times of John J. Pershing* (Texas A&M University Press, 1977), was a finalist for the National Book Award.

After stepping down as president of Texas A&M in 1988, Vandiver returned to teaching and research. He held the John H. and Sara Lindsey Chair in Liberal Arts and also headed the Mosher Institute for Defense Studies, now known as the Mosher Institute of International Policy Studies, for which he raised the money to found during his presidency. Vandiver also remained active in and on the boards of several organizations, among them the American University in Cairo, of which he served as both chairman of the trustees and from 1997 to 1998 acting president. During that time he created the position of dean of libraries and worked to improve collections and services. Today the library is the largest English-language collection in the Arab world. As acting president he also worked to involve the faculty more closely in the university's administration.

He married Susie Smith, with whom he had three children, Nita, Nancy, and Frank Alexander. She died in 1979. In 1980 he married Renee Aubry Carmody, who, along with his three children and six grandchildren, survived him.

—S.E.S.

Stewart G. Wolf
1900–2005

Stewart Wolf was a Renaissance man. He was a physician, teacher, administrator, researcher, scholar, provocateur, and benefactor, and he performed them all with care and dignity. Stewart's creativity, approachability, genuineness, and intellectual curiosity created a presence that attracted students, peers, and colleagues to him as a role model. It is not surprising, therefore, that Stewart's career included academic appointments in medicine, physiology, neurology, psychiatry, and the behavioral sciences. He was an avid interdisciplinarian in his research of "gray areas" in medicine. I would often observe him jotting down ideas in a small notebook he carried in his shirt pocket as he was stimulated by ideas in lectures and symposia. His active, probing mind, and his willingness to take risks in addressing many controversial questions, will be missed beyond the boundaries of medicine. During his distinguished research career he studied the effect of emotional states, including stress, on the gastrointestinal system, the cardiovascular system, and endocrine function. He conducted important studies on the effects of placebos and on the effects of social integration and social support on health and disease.

Stewart was also an excellent physician. He had a keen interest in "the patient as a person" and was a careful observer, listener, and advocate of those under his care. He was dismayed by the bureaucratization of medicine and its effects on Hippocratic ideals.

The broadness of Stewart's lifelong interests stem from his formal education first at the Friends School in Baltimore, Maryland, a year at L'Ecole Alsacienne in Paris, and Phillips Academy. After two years at Yale University he transferred to Johns Hopkins where he received both his A. B. and M. D. degrees. After receiving his M. D., Stewart interned at Cornell-New York Hospital where he collaborated with Dr. Eugene DeBois and later Dr. Harold G. Wolf on studies of pain, neurogenic fever, and the genesis of peptic ulcer. It was his long-term study of one of his patients, Tom, who had a gastric fistula, that led to his first book, titled *Human Gastric Function*, which became a classic.

Stewart Wolf's career later included academic appointments at the University of Oklahoma Medical Center, the University of Texas Medical Branch as Director of the Marine Biomedical Research Center, and after his retirement, as Vice President of St. Luke's Hospital at Bethlehem, Pennsylvania, and Professor of Medicine at Temple University. Throughout his career Stewart enabled young scientists and research fellows the opportunity to work with him and other investigators from throughout the world during summers at Tots Gap Medical Research Laboratories, a small institute he founded in 1958 located in Northeastern Pennsylvania. At Tots Gap, after his retirement, Stewart continued his research into the mechanisms of cardiovascular disease and sudden death, holding interdisciplinary colloquia and hosting professional meetings. He continued to see patients as a consultant on social security disability cases. He also assumed the editorship of the official Journal of the Pavlovian Society, *Integrative Physiological and Behavioral Science.*

Stewart's skill in tennis and his work ethic were unmet challenges for his colleagues. He wrote 35 books and monographs, 77 book chapters, and 437 scientific papers, and was a consultant to institutions throughout the world. He received an Honorary Degree from the University of Göteborg, Sweden, an Award for Outstanding Stress Research from the Karolinska Institute in Stockholm, the prestigious Hans Selye Award from the International Congress on Stress, as well as a Regents' Professorship, and a Dean's Award for Distinguished Service from the University of Oklahoma College of Medicine.

It is ironic that it was Alzheimer's disease that ended more than 60 years of his continuing contributions to understanding how the brain works. He is survived by his wife and two of his three children.

At our last encounter Stewart gave me a copy of a privately printed essay he had discovered written by a namesake, Marcus Wolf, in 1867. The theme was.... "ideas generate and form mind, and not mind ideas!" He smiled as he penciled a reminder in his pocket notebook to learn more about the author of the essay.

—John G. Bruhn

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Past Presidents

*Mirabeau Buonaparte Lamar	1837–59
*Ira Kendrick Stephens	1936
*Charles Shirley Potts	1937
*Edgar Odell Lovett	1938
*George Bannerman Dealey	1939
*George Waverley Briggs	1940
*William James	1941
*George Alfred Hill Jr.	1942
*Edward Henry Cary	1943
*Edward Randall	1944
*Umphrey Lee	1944
*Eugene Perry Locke	1945
*Louis Herman Hubbard	1946
*Pat Ireland Nixon	1947
*Ima Hogg	1948
*Albert Perley Brogan	1949
*William Lockhart Clayton	1950
*A. Frank Smith	1951
*Ernest Lynn Kurth	1952
*Dudley Kezer Woodward Jr.	1953
*Burke Baker	1954
*Jesse Andrews	1955
*James Pinckney Hart	1956
*Robert Gerald Storey	1957
*Lewis Randolph Bryan Jr.	1958
*W. St. John Garwood	1959
*George Crews McGhee	1960
*Harry Huntt Ransom	1961
*Eugene Benjamin Germany	1962
*Rupert Norval Richardson	1963
*Mrs. George Alfred Hill Jr.	1964
*Edward Randall Jr.	1965
*McGruder Ellis Sadler	1966
*William Alexander Kirkland	1967
*Richard Tudor Fleming	1968

*Deceased

*Herbert Pickens Gambrell	1969
*Harris Leon Kempner	1970
*Carey Croneis	1971
*Willis McDonald Tate	1972
*Dillon Anderson	1973
*Logan Wilson	1974
*Edward Clark	1975
Thomas Hart Law	1976
*Truman G. Blocker Jr.	1977
*Frank E. Vandiver	1978
*Price Daniel	1979
Durwood Fleming	1980
Charles A. LeMaistre	1981
*Abner V. McCall	1982
*Leon Jaworski	1983
Wayne H. Holtzman	1983
Jenkins Garrett	1984
Joe R. Greenhill	1985
William Pettus Hobby	1986
Elspeth Rostow	1987
John Clifton Caldwell	1988
J. Chrys Dougherty III	1989
*Frank McReynolds Wozencraft	1990
William C. Levin	1991
*William D. Seybold	1992
Robert Krueger	1993
Steven Weinberg	1994
*William H. Crook	1995
*Charles C. Sprague	1996
Jack S. Blanton	1997
William P. Wright Jr.	1998
Patricia Hayes	1999
A. Baker Duncan	2000
Ellen C. Temple	2001
George C. Wright	2002
J. Sam Moore Jr.	2003
Alfred F. Hurley	2004
Harris L. Kempner Jr.	2005

*Deceased

MEETINGS

of The Philosophical Society of Texas

1837—Founded at Houston, December 5
1840—Austin, January 29
1936—Chartered, January 18
1936—Reorganizational meeting—Dallas, December 5
1937—Meeting and inaugural banquet—Dallas, January 29
1937—Liendo and Houston, December 4
1938—Dallas
1939—Dallas
1940—San Antonio
1941—Austin
1942—Dallas
1943—Dallas
1944—Dallas
1945—Dallas
1946—Dallas
1947—San Antonio
1948—Houston
1949—Austin
1950—Houston
1951—Lufkin
1952—College Station
1953—Dallas
1954—Austin
1955—Nacogdoches
1956—Austin
1957—Dallas
1958—Austin
1959—San Antonio
1960—Fort Clark
1961—Salado
1962—Salado
1963—Nacogdoches
1964—Austin
1965—Salado
1966—Salado
1967—Arlington
1968—San Antonio
1969—Salado
1970—Salado
1971—Nacogdoches
1972—Dallas
1973—Austin (Lakeway Inn)
1974—Austin
1975—Fort Worth
1976—San Antonio
1977—Galveston
1978—Houston
1979—Austin
1980—San Antonio
1981—Dallas
1982—Galveston
1983—Fort Worth
1984—Houston
1985—College Station
1986—Austin
1987—Kerrville
1988—Dallas
1989—San Antonio
1990—Houston
1991—Galveston
1992—Dallas
1993—Laredo
1994—Austin
1995—Corpus Christi
1996—Dallas
1997—Houston
1998—Abilene
1999—Austin
2000—San Antonio
2001—Austin
2002—Fort Worth
2003—El Paso
2004—Denton
2005—Galveston

PREAMBLE

We the undersigned form ourselves into a society for the collection and diffusion of knowledge—subscribing fully to the opinion of Lord Chancellor Bacon, that "knowledge is power"; we need not here dilate on its importance. The field of our researches is as boundless in its extent and as various in its character as the subjects of knowledge are numberless and diversified. But our object more especially at the present time is to concentrate the efforts of the enlightened and patriotic citizens of Texas, of our distinguished military commanders and travelers,—of our scholars and men of science, of our learned members of the different professions, in the collection and diffusion of correct information regarding the moral and social condition of our country; its finances, statistics and political and military history; its climate, soil and productions; the animals which roam over our broad prairies or swim in our noble streams; the customs, language and history of the aboriginal tribes who hunt or plunder on our borders; the natural curiosities of the country; our mines of untold wealth, and the thousand other topics of interest which our new and rising republic unfolds to the philosopher, the scholar and the man of the world. Texas having fought the battles of liberty, and triumphantly achieved a separate political existence, now thrown upon her internal resources for the permanence of her institutions, moral and political, calls upon all persons to use all their efforts for the increase and diffusion of useful knowledge and sound information; to take measures that she be rightly appreciated abroad, and acquire promptly and fully sustain the high standing to which she is destined among the civilized nations of the world. She calls on her intelligent and patriotic citizens to furnish to the rising generation the means of instruction within our own borders, where our children—to whose charge after all the vestal flame of Texian liberty must be committed—may be indoctrinated in sound principles and imbibe with their education respect for their country's laws, love of her soil and veneration for her institutions. We have endeavored to respond to this call by the formation of this society, with the hope that if not to us, to our sons and successors it may be given to make the star, the single star of the West, as resplendent for all the acts that adorn civilized life as it is now glorious in military renown. Texas has her captains, let her have her wise men.

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(Name of Spouse Appears in Parentheses)

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CULLUM, LEE, journalist contributing columns to Dallas *Morning News* and commentaries to National Public Radio's *All Things Considered* and to *News Hour with Jim Lehrer;* author of *Genius Came Early: Creativity in the Twentieth Century*, *Dallas*

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DAILEY, MACEO (SONDRA), director of African American Studies and assistant professor of history at The University of Texas at El Paso; board chair of Humanities Texas, *El Paso*

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LABOON, ROBERT BRUCE (RAMONA), partner, Locke Liddell & Sapp, *Houston*

LARIVIERE, RICHARD W. (JANIS), dean, College of Liberal Arts, The University of Texas at Austin, *Austin*

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LOWE, RICHARD (KATHY), Regents Professor, University of North Texas; author and recipient of Jefferson Davis Award of the Museum of the Confederacy for *Walker's Texas Division, CSA: Greyhounds of the Trans-Mississippi*, author of several books, *Denton*

LOWMAN, ALBERT T. (DARLYNE), past president, Texas Folklore Society, Book Club of Texas, Texas State Historical Association; managing partner, Lowman Ranch, Ltd., *San Marcos*

MACKINTOSH, PRUDENCE M. (JOHN), author; member, Texas Institute of Letters, *Dallas*

MACON, JANE (LARRY), attorney, city and trial attorney, City of San Antonio, *San Antonio*

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MARTIN, ROBERT S. (BARBARA), director, Institute for Museum and Library Sciences; former director, Texas State Library, *Corinth and Washington, D.C.*

MARTINEZ, PHILIP, El Paso district judge; former director El Paso Legal Assistance Society, El Paso Holocast Museum, El Paso Cancer Treatment Center, and Hispanic Leadership Institute, *El Paso*

MARZIO, PETER CORT, director, the Museum of Fine Arts, Houston, *Houston*

MATTHEWS, JUDY JONES, president, Dodge Jones Foundation, *Abilene*

MATTHEWS, KATHLEEN SHIVE, dean, Wiess School of Natural Sciences, Rioce University; elected to American Association for the Advancement of Science, *Houston*

MCCOMBS, B. J. "RED" (CHARLINE), owner, Minnesota Vikings, *San Antonio*

MCCORQUODALE, ROBIN HUNT; novelist, *Houston*

MCCOWN, F. SCOTT (MAURA POWERS), executive director, Center for Public Policy Priorities, retired judge, 345th District Court, Travis County, Texas, named by *Texas Monthly* as one of "The 25 Most Powerful People in Texas Politics," *Austin*

MCDERMOTT, MARGARET (EUGENE), The University of Texas at Austin Distinguished Alumna; patron of the arts, education, and medicine in various community involvements; member, International council of Museum of Modern Art in New York and the Dallas Shakespeare Club; honorary alumnus of the Massachusetts Institute of Technology, *Dallas*

MCFADDEN, JOSEPH M., president emeritus, professor of history, University of St. Thomas, *Houston*

MCHUGH, M. COLLEEN, partner, Bracewell & Patterson, L.L.P., *Corpus Christi*

MCKNIGHT, JOSEPH WEBB (MIMI), professor, Southern Methodist School of Law; legal historian; law reformer, *Dallas*

McLaughlin, John Mark (Amy), rancher, lawyer, and chairman of Texas State Bank, *San Angelo*

McNeill, Larry, board member, Texas State Historical Association; board member, Texas Supreme Court Historical Society; president, managing shareholder, Clark, Thomas & Winters, P.C., *Austin*

McReynolds, Jim (Judy), member, Texas House of Representatives; former faculty member, Stephen F. Austin State University; owner, Chapparal Energy, Inc., *Lufkin*

Middleton, Harry J. (Miriam), director emeritus, Lyndon B. Johnson Presidential Library and Museum; exeutive director, Lyndon B. Johnson Foundation, *Austin*

Miller, Charles (Beth), chairman, Meridian National, Inc., *Houston*

Monday, Jane Clements (Charles), former regent, Texas State University System; public commissioner, Southern Associatgion of College and Schools; author, *Huntsville*

Moore, J. Sam, Jr. (Greta), retired lawyer; former chairman, Texas Committee for the Humanities; former member, Texas Law Review Association, *El Paso*

Moseley, John Dean (Sara Bernice), president emeritus, Austin College; former director, Texas Legislative Council; consultant, *Sherman*

Mosle, Paula Meredith (Jon), trustee and chairman, Hockaday School; former dean of women, Rice University; former governor current trustee advisor, Rice University, *Dallas*

Mullins, Charles B. (Stella), professor of internal medicine, J. Fred Schoelkopf, Jr. chair in cardiology, The University of Texas Southwestern Medical Center, *Dallas*

Murphy, Ewell E., Jr., lawyer, retired partner, Baker & Botts L.L.P.; distinguished lecturer, University of Houston Law Center, *Houston*

Natalicio, Diana S., president, University of Texas at El Paso; member, Texas Women's Hall of Fame; author, *El Paso*

Nicklaus, Helen Carol (Ted), The University of Texas Liberal Arts Foundation Advisory Council, recipient of the Jim Veninga Award for Excellence in Humanities, Texas Council for the Humanities; M.A. Philosophy, University of Utah, *Amarillo*

Olson, Lyndon L., Jr. (Kay), former U.S. Ambassador to Sweden, *Waco*

Oxford, Patrick Cunningham (Kate), managing partner, Bracewell & Giuliani L.L.P.; board of regents, The University of Texas System; board member, M.D. Anderson Outreach, Inc. and Texas Medical Giants, *Houston*

Palaima, Thomas G. (Carolyn), professor of Classics at The University of Texas at Austin, *Austin*

PHILLIPS, THOMAS ROYAL (LYN), chief justice, Supreme Court of Texas, *Austin*

POPE, JACK (ALLENE), former chief justice, Supreme Court of Texas, *Austin*

PORTER-SCOTT, JENNY LIND (LAWRENCE E.), poet and educator, former poet laureate of Texas, *Austin and Los Angeles, CA*

POWELL, BOONE (DIANNE), chairman, Ford, Powell, & Carson, Architects; College of Fellows, American Institute of Architexts; former president, Texas Society of Architects; peer professional, U.S. General Services Administration, *San Antonio*

POWERS, WILLIAM C., dean, School of Law, The University of Texas at Austin; John Jeffers Research Chair in Law, Hines H. Baker and Thelma Kelly Baker Chair, University Distinguished Teaching Professor, *Austin*

PRADO, EDWARD C. (MARIA), U.S. Circuit Judge, U.S. Court of Appeals; former U.S. District Court Judge, Western District of Texas; former U.S. Attorney, Western District of Texas, *San Antonio*

PRESSLER, H. PAUL, III (NANCY), justice (retired), Court of Appeals of Texas, Fourteenth Supreme Judicial District, *Houston*

PROTHRO, CAREN H. (C. VINCENT), member of board of Dallas Museum of Art, Dallas Center for the Performing Arts Foundation, and Southwestern Medical Foundation, *Dallas*

RAMEY, TOM B., JR. (JILL), lawyer; chief justice, Twelfth Court of Appeals, *Tyler*

RAMIREZ, MARIO E. (SARAH), physician; past member, board of regents, the University of Texas System, vice-president for South Texas Initiatives University of Texas Health Science Center San Antonio, *Rio Grande City*

RANDALL, EDWARD, III (ELLEN), private investor; board of directors, EOG Resources Inc., Kinder Morgan, Inc., and EcPutlook.com,Inc., *Houston*

RANDALL, RISHER (FAIRFAX), former senior vice president and director, American General Investment Corporation; manager, family trusts, investments, and real estate, *Houston*

REASONER, HARRY MAX (MACEY), lawyer; senior partner, Vinson & Elkins, *Houston*

REAUD, WAYNE A., attorney and philanthropist; member of The University of Texas System Chancellor's Council, *Beaumont*

REAVLEY, THOMAS M. (CAROLYN DINEEN KING), judge, U.S. Court of Appeals, Fifth Circuit, *Houston*

REYNOLDS, HERBERT H. (JOY), president emeritus, Baylor University; Air Force/NASA psychologist and neuroscientist, 1948–1968, *Waco*

RHODES, CHARLOTTE W. (ALEC), patron, Shakespeare at Winedale; chancellor's council, The University of Texas at Austin; Harry Ransom Humanities Research Center Advisory Council, The University of Texas at Austin, *Dripping Springs*

ROBINSON, MARY LOU, U.S. district judge; former state appellate and trial judge, *Amarillo*

RODRIGUEZ, EDUARDO ROBERTO, attorney, Rodriguez, Colvin & Chaney, L.L.P., *Brownsville*

RODRIGUEZ, RAUL (LORENA), managing director and CEO, North American Development Bank, *San Antonio*

ROMO, RICARDO (HARRIETT), president, The University of Texas at San Antonio, *San Antonio*

ROSTOW, ELSPETH (WALT), Stiles Professor Emerita, former dean, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, *Austin*

ROVE, KARL C. (DARBY), senior advisor and assistant to the President of the United States, *Washington, D.C.*

RUTFORD, ROBERT HOXIE (MARJORIE ANN), Excellence in Education Foundation Chair in Geoscience, The University of Texas at Dallas; former president, The University of Texas at Dallas; former director, Division of Polar Programs, National Science Foundation; president, Scientific Committee on Antarctic Research, *Richardson*

SANSOM, ANDREW (NONA), executive director, River Systems Institute and Research Professor of Geography at Texas State University San Marcos; former executive director, Texas Parks & Wildlife Department; executive director, Texas Nature Conservancy; founder, The Parks and Wildlife Foundation of Texas, *San Marcos*

SCHRUM, JAKE B. (JANE), president, Southwestern University, *Georgetown*

SCHWITTERS, ROY F. (KAREN), S. W. Richardson Regents Chair in Physics, The University of Texas at Austin; former director, Super Conducting Super Collider, *Austin*

SELDIN, DONALD W., William Buchanan and The University of Texas System Professor of Internal Medicine, The University of Texas Southwestern Medical School, *Dallas*

SHERMAN, MAX RAY (GENE ALICE), professor and dean emeritus, Lyndon Baines Johnson School of Public Affairs, The University of Texas at Austin; former president, West Texas State University, *Austin*

SHILLING, ROY B., JR. (MARGARET), president emeritus, Southwestern University, *Austin*

SHIPLEY, GEORGE, president and chief executive officer, Shipley & Associates, Inc., *Austin*

SHIVERS, ALLAN "BUD", JR. (ROBIN), chairman, Shivers Group, Inc.; chairman, Seton Fund, *Austin*

SMITH, BEA, Texas Court of Appeals in Austin, Adjunct Professor, The University of Texas School of Law, *Austin*

SMITH, CULLEN (MICKEY), attorney, former president of the State Bar of Texas; member, Advisory Council, College of the Arts and Sciences, Baylor University, *China Spring*

SMITH, EVAN, editor, *Texas Monthly*; secretary of the Boards of the American Society of Magazine Editors and the Austin Film Society; member of the Boards of the Jack S. Blanton Museum of Art, the Headliners Club, Marfa Public Radio, and Austin public television station, KLRU, *Austin*

SMITH, FRANK C., JR. (KATHERINE), electrical engineer; specialist in data processing and geosciences, *Houston*

SMITH, STEVEN ESCAR (NATALIE), director and C. Clifford Wendler Professor, Cushing Memorial Library and Archives, and associate dean for advancement, Texas A&M University Libraries, *College Station*

SPECTOR, ROSE (MORRIS), former Texas Supreme Court Justice, trial judge, and District Judge, *San Antonio*

SPIVEY, BROADUS A. (RUTH ANN), past president, State Bar of Texas, shareholder, Spivey & Ainsworth P.C., *Austin*

STALEY, THOMAS (CAROLYN), director, Harry Ransom Humanities Research Center; Harry Ransom Chair of Liberal Arts; professor of English, The University of Texas at Austin, *Austin*

STEINER, FREDERICK (ANNA), dean, School of Architecture, The University of Texas at Austin; Henry M. Rockwell Chair in Architecture, *Austin*

STEPHENS, F .L. "STEVE" (POLLYANNA), former chairman, CEO, and cofounder, Town & Country Food Stores, Inc., *San Angelo*

STEVES, EDWARD GALT (NANCY), CEO, Steves & Sons, Inc.; member, Board of Directors, Chase Texas Bank; member, Young Presidents' Organization, *San Antonio*

STOBO, JOHN D. (MARY ANN), president, The University of Texas Medical Branch, *Galveston*

STOREY, CHARLES PORTER (HELEN), lawyer; trustee; former chairman, The Southwestern Legal Foundation, *Dallas*

STOREY, CHARLES PORTER, JR. (GAIL), physician; author; medical director, St. Luke's Episcopal Hospital Palliative Care Service, associate professor of medicine, Baylor College of Medicine, *Houston*

STRAYHORN, CAROLE KEETON (ED), former Comptroller of Public Accounts; former Texas Railroad Commissioner; Mayor of Austin;

president, Austin Community College Board of Trustees; president, Austin Independent School District Board, *Austin*

STRONG, LOUISE CONNALLY (BEEMAN), professor of medical genetics; Sue and Radcliffe Chair, The University of Texas System Cancer Center; Phi Beta Kappa, *Houston*

STUART, ANN, Chancellor & President Texas Woman's University, past President, Rensselaer at Hartford, Connecticut, *Denton*

STUART, CLAUDIA (HAROLD), professor of Sociology, Criminal Justice, and Sports and Exercise Sciences at West Texas A&M University; author, *My Private Stock, Expressions, All Along Life's Journey* and *Living Out Loud, An Anthology of Poetry*, co-author *Sociology—The New Millennium*, second edition, *Amarillo*

SULLIVAN, TERESA A. (DOUG LAYCOCK), vice president and graduate dean, professor of sociology and law, Cox & Smith Faculty Fellow in Law at The University of Texas at Austin, *Austin*

SUTTON, JOHN F. (NANCY), A. W. Walker Centennial Chair in Law Emeritus, The University of Texas at Austin; former dean, The University Texas Law School; former practicing attorney, San Antonio and San Angelo, *Austin and San Angelo*

TAYLOR, LONN (DEDIE), historian, *Fort Davis*

TEMPLE, ELLEN C. (ARTHUR "BUDDY" III), former member and vice-chair, board of regents, The University of Texas System; publisher, Ellen C. Temple Publishing, Inc., *Lufkin*

TEMPLE, LARRY (LOUANN), lawyer; former chairman, Texas Higher Education Coordinating Board, *Austin*

THOMASSON, CHARLES W. (WILLA), lawyer, *Corpus Christi*

THOMPSON, JERRY D. (SARA), dean of the College of Arts and Humanities and professor of history at Texas A&M International University, *Laredo*

TOBIN, DON, (PEGGY), former president, American Association of Petroleum Geologists, *Bandera*

TOTTEN, HERMAN LAVON, dean, School of Library & Information Sciences, University of North Texas; member, National Commission on Library & Information Science; former president, Texas Library Association, *Denton*

TRAUTH, DENISE, president, Texas State University; writer, *San Marcus*

TROTTER, BILLY BOB (PEGGY), pathologist; emeritus director, Laboratories of Hendrick Medical Center, *Abilene*

TYLER, RON C. (PAULA), director, Amon Carter Museum, Fort Worth; former director, Texas State Historical Association and the Center for Studies in Texas History; former professor of history, The University of Texas at Austin, *Fort Worth*

VENINGA, JAMES F. (CATHERINE WILLIAMS), CEO and campus dean University of Wisconsin-Marathon County, *Wausau, WI*

VENNEMA, DIANE STANLEY (PETER), author and illustrator, *Houston*

VICK, FRANCES BRANNEN (ROSS), former director and co-founder, University of North Texas Press; councilor, Texas Institute of Letters and Texas Folklore Society; board, Texas Council for the Humanities, *Dallas*

WAINERDI, RICHARD E. (ANGELA), president and CEO, Texas Medical Center, *Houston*

WALKER, E. LEE (JENNIFER VICKERS), chairman, Lance Armstrong Foundation, chairman, Capitol Metro Transportation Authority, 1998 Austinite of the Year, *Austin*

WARNER, DAVID C. (PHYLLIS), professor in the Lyndon Baines Johnson School of Public Affairs, The University of Texas at Austin, *Austin*

WEDDINGTON, SARAH RAGLE, lawyer; adjunct professor, The University of Texas at Austin; former member, Texas House of Representatives; former assistant to the president of the United States; former general counsel, U.S. Department of Agriculture; author, *Austin*

WEINBERG, LOUISE (STEVEN), holder of the Bates Chair and Professor of Law, The University of Texas at Austin, *Austin*

WEINBERG, STEVEN (LOUISE), Josey Regental Professor of Science, The University of Texas at Austin; Nobel Prize in physics; research and publications in physics and astronomy, *Austin*

WHEELER, JOHN ARCHIBALD (JANETTE), Ashbel Smith Professor Emeritus of Physics; former director, Center of Theoretical Physics, The University of Texas at Austin, *Hightstown, NJ*

WHITE, FRED NEWTON, JR. (ROSANNE), emeritus professor of medicine at Scripps Institution of Oceanography, University of California at San Diego, *San Antonio*

WHITMORE, JON S. (JENNIFER), president, Texas Tech University, *Lubbock*

WHITTENBURG, GEORGE (ANN), lawyer; member, Council of the American Law Institute; Life Fellow, American Bar Foundation, *Amarillo*

WILDENTHAL, C. KERN (MARGARET), president, The University of Texas Southwestern Medical Center, *Dallas*

WILHELM, MARILYN, founder-director, Wilhelm Schole International; author, *Houston*

WILSON, ISABEL BROWN (WALLACE S.), board of trustees: The Brown Foundation, Houston; Smith College, Northampton, MA; chairman, Museum of Fine Arts, Houston; board of visitors, The University of Texas M.D. Anderson Cancer Center; advisory board, J.P. Morgan Chase Bank, Texas, *Houston*

WILSON, ROSINE MCFADDIN, historian and author; former president, Texas Historical Foundation; vice-chairman, Texas Historical Commission; president of the board, McFaddin-Ward House Museum; trustee, McFaddin-Ward Foundation; trustee, San Jacinto Museum of History, *Beaumont*

*WINFREY, DORMAN HAYWARD (RUTH CAROLYN), former secretary, Philosophical Society of Texas; former director, Texas State Library, *Austin*

WINTERS, J. SAM (DOROTHY), lawyer, *Austin*

WISE, WILLIAM A. (MARIE), chairman of the board, president, and chief executive officer of El Paso Corporation, *Houston*

WITTLIFF, WILLIAM DALE (SALLY), typographer and publisher; president, Encino Press; movie scriptwriter and film producer; councilor, Texas Institute of Letters, *Austin*

WOODRUFF, PAUL (LUCIA), professor of philosophy, The University of Texas at Austin; author, *Austin*

WORSHAM, JOS. IRION (HARRIET), lawyer, Hunton & Williams, *Dallas*

WRIGHT, GEORGE CARLTON (VALERIE), provost and executive vice-president for academic affairs, University of Texas at Arlington, *Arlington*

WRIGHT, JAMES S. (MARY), architect; senior partner, Page Southerland Page, *Dallas*

WRIGHT, LAWRENCE GEORGE (ROBERTA), author; staff writer, *The New Yorker*; screenwriter, *Austin*

WRIGHT, WILLIAM P. "BILL", JR. (ALICE), investments, author, photographer, former chairman, Western Marketing, Inc.; former member, National Council on the Humanities; former chairman, Texas Council on the Humanities; board of managers, School of American Research, Santa Fe; director, National Trust for the Humanities; The University of Texas Press Advisory Council; commissioner, Texas Commission on the Arts, *Abilene*

YEAGER, KATHLEEN "KAY" (FRANK), former mayor, Wichita Falls, *Wichita Falls*

YOUNG, BARNEY T. (SALLY), founding partner, Rain, Harrell, Emery, Young, and Duke; of counsel, Locke, Liddell & Sapp, *Dallas*

YUDOF, MARK G. (JUDY), former chancellor, The University of Texas System, former president, University of Minnesota, *Austin*

ZAFFIRINI, JUDITH (CARLOS), senator for the twenty-first district of Texas; owner, Zaffirini communications, *Laredo*

*Life Member
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In Memoriam

(Date indicates year of Proceedings in which memorial is published.)

SAMUEL HANNA ACHESON (1971)
NATHAN ADAMS (1966)
CLAUDE CARROLL ALBRITTON JR. (1997)
JAMES PATTERSON ALEXANDER (1948)
AUGUSTUS C. ALLEN
WINNIE ALLEN (1985)
DILLON ANDERSON (1973)
ROBERT BERNERD ANDERSON (1990)
JESSE ANDREWS (1961)
MARK EDWIN ANDREWS (1992)
THOMAS REEVES ARMSTRONG
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WILLIAM HAWLEY ATWELL (1961)
KENNETH HAZEN AYNESWORTH (1944)
BURKE BAKER (1964)
HINES HOLT BAKER
JAMES ADDISON BAKER (1941)
JOSEPH BAKER
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EDWARD CHRISTIAN HENRY BANTEL (1964)
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EUGENE CAMPBELL BARKER (1956)
MAGGIE WILKINS HILL BARRY (1945)
WILLIAM BARTHOLOMEW BATES (1974)
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WILLIAM JAMES BATTLE (1955)
WILLIAM BENNETT BEAN (1989)
HENRY M. BELL JR. (19990
WARREN SYLVANUS BELLOWS (1966)
HARRY YANDELL BENEDICT (1937)
JOHN MIRZA BENNETT JR. (1993)
GEORGE JOHN BETO (1991)
JOHN HAMILTON BICKETT JR. (1947)
WILLIAM CAMPBELL BINKLEY (1970)
JOHN BIRDSALL
CHARLES MCTYEIRE BISHOP (1949)
WILLIAM BENNETT BIZZELL (1944)
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TRUMAN G. BLOCKER JR. (1984)
ROBERT LEE BOBBITT
MEYER BODANSKY (1941)
HERBERT EUGENE BOLTON (1953)
CHARLES PAUL BONER (1979)
GEORGE W. BONNELL
JOHN GUTZON DE LA MOTHE BORGLUM (1941)
HOWARD TANEY BOYD (1991)
PAUL LEWIS BOYNTON (1958)
EDWARD T. BRANCH
LEO BREWSTER (1980)
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ANDREW DAVIS BRUCE (1968)
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LEWIS RANDOLPH BRYAN JR. (1959)
BOB BULLOCK
JOHN W. BUNTON
RICHARD FENNER BURGES (1945)
WILLIAM HENRY BURGES (1946)
EMMA KYLE BURLESON (1941)
JOHN HILL BURLESON (1959)
DAVID G. BURNET
I. W. BURTON
GEORGE A. BUTLER (1992)
JACK L. BUTLER (1990)
CHARLES PEARRE CABELL (1970)
CLIFTON M. CALDWELL
GEORGE CARMACK (2002)
JOHN WILLIAM CARPENTER
EVELYN M. CARRINGTON (1985)
PAUL CARRINGTON (1989)
H. BAILEY CARROLL (1966)
MARY JO CARROLL (1994)
EDWARD HENRY CARY (1954)
ALBERT V. CASEY (2004)

CARLOS EDUARDO CASTAÑEDA (1958)
THOMAS JEFFERSON CHAMBERS
ASA CRAWFORD CHANDLER (1958)
MARION NELSON CHRESTMAN (1948)
EDWARD A. CLARK (1992)
JOSEPH LYNN CLARK (1969)
RANDOLPH LEE CLARK (1993)
TOM C. CLARK
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THOMAS STONE CLYCE (1946)
CLAUDE CARR CODY JR. (1960)
HENRY COHEN (1952)
HENRY CORNICK COKE JR. (1982)
MARVIN KEY COLLIE (1990)
JAMES COLLINSWORTH
ROGER N. CONGER (1996)
JOHN BOWDEN CONNALLY JR. (1994)
TOM CONNALLY (1963)
ARTHUR BENJAMIN CONNOR
C.W.W. "TEX" COOK (2003)
JOHN H. COOPER (1993)
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CLARENCE COTTAM (1974)
MARGARET COUSINS (1996)
MARTIN MCNULTY CRANE (1943)
CAREY CRONEIS (1971)
WILLIAM H. CROOK (1997)
JOSEPH STEPHEN CULLINAN (1937)
NINA CULLINAN
ROBERT B. CULLOM
MINNIE FISHER CUNNINGHAM
THOMAS WHITE CURRIE (1943)
JEAN HOUSTON BALDWIN DANIEL (2003)
PRICE DANIEL (1992)
WILLIAM E. DARDEN (1998)
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MORGAN JONES DAVIS (1980)
GEORGE BANNERMAN DEALEY (1946)
JAMES QUAYLE DEALEY
EVERETT LEE DEGOLYER (1957)
GILBERT DENMAN (2004)
EDGAR A. DEWITT (1975)
ROSCOE PLIMPTON DEWITT
ADINA DEZAVALA (1955)
FAGAN DICKSON
CHARLES SANFORD DIEHL (1946)
FRANK CLIFFORD DILLARD (1939)
J. FRANK DOBIE (1964)
EZRA WILLIAM DOTY (1994)
GERRY DOYLE (1999)
HENRY PATRICK DROUGHT (1958)
FREDERICA GROSS DUDLEY
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J. CONRAD DUNAGAN (1994)
CLYDE EAGLETON (1958)
DWIGHT DAVID EISENHOWER
EDWIN A. ELLIOTT
ALEXANDER CASWELL ELLIS (1948)
JOE EWING ESTES (1991)
HYMAN JOSEPH ETTLINGER (1986)
LUTHER HARRIS EVANS
WILLIAM MAURICE EWING (1973)
WILLIAM STAMPS FARISH (1942)
SARAH ROACH FARNSWORTH
CHARLES W. FERGUSON
JOE J. FISHER (2000)
STERLING WESLEY FISHER
LAMAR FLEMING JR. (1964)
RICHARD TUDOR FLEMING (1973)
FRED FARRELL FLORENCE (1960)
JAMES LAWRENCE FLY
PAUL JOSEPH FOIK (1941)
LITTLETON FOWLER
CHARLES INGE FRANCIS (1969)
JOE B. FRANTZ (1993)
LLERENA BEAUFORT FRIEND (1998)
JESSE NEWMAN GALLAGHER (1943)
HERBERT PICKENS GAMBRELL (1983)
VIRGINIA LEDDY GAMBRELL (1978)
WILMER ST. JOHN GARWOOD (1989)
MARY EDNA GEARING (1946)
SAMUEL WOOD GEISER (1983)
EUGENE BENJAMIN GERMANY (1970)
ROBERT RANDLE GILBERT (1971)
GIBB GILCHRIST (1972)
JOHN WILLIAM GORMLEY (1949)
MALCOLM KINTNER GRAHAM (1941)
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IRELAND GRAVES (1969)
MARVIN LEE GRAVES (1953)
WILLIAM FAIRFAX GRAY
LEON A. GREEN (1979)
NEWTON GRESHAM (1996)
DAVID WENDELL GUION (1981)
CHARLES WILSON HACKETT (1951)
WALTER GARNER HALL (2000)
JOHN HENRY HANNAH JR. (2003)
RALPH HANNA
HARRY CLAY HANSZEN (1950)
FRANKLIN ISRAEL HARBACH (1998)
THORNTON HARDIE (1969)
HELEN HARGRAVE (1984)
JAMES M. HARGROVE (2004)
HENRY WINSTON HARPER (1943)
MARION THOMAS HARRINGTON
GUY BRYAN HARRISON JR. (1988)

TINSLEY RANDOLPH HARRISON
JAMES PINCKNEY HART (1987)
HOUSTON HARTE (1971)
RUTH HARTGRAVES (1995)
FRANK LEE HAWKINS (1954)
WILLIAM WOMACK HEATH (1973)
ERWIN HEINEN (1997)
JACOB W. HERSHEY (2000)
J. CARL HERTZOG (1988)
JOHN EDWARD HICKMAN (1962)
GEORGE ALFRED HILL JR. (1949)
GEORGE ALFRED HILL III (1974)
GEORGE W. HILL (1985)
JOSEPH M. HILL (1999)
MARY VAN DEN BERGE HILL (1965)
ROBERT THOMAS HILL (1941)
JOHN E. HINES (1998)
OVETA CULP HOBBY (1995)
WILLIAM PETTUS HOBBY (1964)
ELA HOCKADAY (1956)
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IMA HOGG (1975)
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EUGENE HOLMAN (1962)
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A. C. HORTON
EDWARD MANDELL HOUSE (1939)
ANDREW JACKSON HOUSTON (1941)
SAM HOUSTON
WILLIAM VERMILLION HOUSTON (1969)
WILLIAM EAGER HOWARD (1948)
LOUIS HERMAN HUBBARD (1972)
JOHN AUGUSTUS HULEN (1957)
WILMER BRADY HUNT (1982)
FRANK GRANGER HUNTRESS (1955)
PETER HURD
HOBART HUSON
JOSEPH CHAPPELL HUTCHESON JR.
JUNE HYER (1980)
JULIA BEDFORD IDESON (1945)
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R. A. IRION
WATROUS HENRY IRONS (1969)
PATRICK C. JACK
HERMAN GERLACH JAMES (1966)
LEON JAWORSKI (1982)
JOHN LEROY JEFFERS (1979)
JOHN HOLMES JENKINS III (1991)
HERBERT SPENCER JENNINGS (1966)
LYNDON BAINES JOHNSON (1973)
WILLIAM PARKS JOHNSON (1970)
MARGUERITE JOHNSTON (2005)
ANSON JONES
CLIFFORD BARTLETT JONES (1973)
ERIN BAIN JONES (1974)
EVERETT HOLLAND JONES (1996)
HOWARD MUMFORD JONES
JESSE HOLMAN JONES (1956)
JOHN TILFORD JONES JR. (1993)
MARVIN JONES (1977)
MRS. PERCY JONES (1978)
JOHN ERIK JONSSON (1996)
JACK S. JOSEY (2004)
DAVID S. KAUFMAN
PAGE KEETON
HERBERT ANTHONY KELLAR (1955)
ROBERT MARVIN KELLY (1958)
LOUIS WILTZ KEMP (1956)
HARRIS LEON KEMPNER SR. (1987)
THOMAS MARTIN KENNERLY (1966)
DANIEL E. KILGORE (1995)
WILLIAM JACKSON KILGORE (1993)
EDWARD KILMAN (1969)
FRANK HAVILAND KING
WILLIAM ALEXANDER KIRKLAND (1988)
ROBERT JUSTUS KLEBERG JR. (1974)
DOROTHY W. KNEPPER (1998)
JOHN FRANCIS KNOTT
GEORGE KOZMETSKY (2003)
LAURA LETTIE SMITH KREY (1985)
ERNEST LYNN KURTH (1960)
POLYKARP KUSCH (1993)
LUCIUS MIRABEAU LAMAR III (1978)
MIRABEAU B. LAMAR
FRANCIS MARION LAW (1970)
F. LEE LAWRENCE (1996)
CHAUNCEY DEPEW LEAKE (1978)
AMY FREEMAN LEE (2004)
UMPHREY LEE (1958)
DAVID LEFKOWITZ (1956)
MARK LEMMON (1975)
J. HUGH LIEDTKE (2003)
JEWEL PRESTON LIGHTFOOT (1950)
DENTON RAY LINDLEY (1986)
EUGENE PERRY LOCKE (1946)
JOHN AVERY LOMAX (1948)
WALTER EWING LONG (1973)
JOHN TIPTON LONSDALE (1960)
EDGAR ODELL LOVETT (1957)
H. MALCOLM LOVETT
ROBERT EMMET LUCEY (1977)
WILLIAM WRIGHT LYNCH
ABNER VERNON MCCALL (1995)
JOHN LAWTON MCCARTY
JAMES WOOTEN MCCLENDON (1972)
L. F. MCCOLLUM (1996)
CHARLES TILFORD MCCORMICK (1964)
IRELINE DEWITT MCCORMICK

MALCOLM MCCORQUODALE JR. (1990)
JOHN W. MCCULLOUGH (1987)
TOM LEE MCCULLOUGH (1966)
EUGENE MCDERMOTT
GEORGE CREWS MCGHEE (2005)
JOHN HATHAWAY MCGINNIS (1960)
ROBERT C. MCGINNIS (1994)
GEORGE LESCHER MACGREGOR (2001)
STUART MALOLM MCGREGOR
ALAN DUGALD MCKILLOP (1974)
BUKNER ABERNATHY MCKINNEY (1966)
HUGH MCLEOD
LEWIS WINSLOW MACNAUGHTON (1969)
AYLMER GREEN MCNEESE JR. (1992)
ANGUS MCNEILL
JOHN OLIVER MCREYNOLDS (1942)
JACK R. MAGUIRE (2001)
HENRY NEIL MALLON
GERALD C. MANN (1989)
STANLEY MARCUS (2001)
JOHN L. MARGRAVE (2005)
FRANK BURR MARSH (1940)
HARRIS MASTERSON III (1997)
WATT R. MATTHEWS (1997)
MAURY MAVERICK (1954)
BALLINGER MILLS JR. (1992)
BALLINGER MILLS SR. (1947)
MERTON MELROSE MINTER (1978)
PETER MOLYNEAUX
JAMES TALIAFERRO MONTGOMERY (1939)
DAN MOODY (1966)
DAN MOODY JR. (2000)
BERNICE MILBURN MOORE (1993)
FRED HOLMSLEY MOORE (1985)
MAURICE THOMPSON MOORE
TEMPLE HOUSTON MORROW
JAMES M. MOUDY (2004)
WILLIAM OWEN MURRAY (1973)
FRED MERRIAM NELSON
CHESTER WILLIAM NIMITZ (1965)
PAT IRELAND NIXON (1965)
MARY MOODY NORTHEN (1991)
JAMES RANKIN NORVELL (1969)
CHILTON O'BRIEN (1983)
DENNIS O'CONNOR (1997)
CHARLES FRANCIS O'DONNELL (1948)
JOSEPH GRUNDY O'DONOHOE (1956)
LEVI ARTHUR OLAN (1984)
TRUEMAN EDGAR O'QUINN (1989)
JOHN ELZY OWENS (1951)
WILLIAM A. OWENS (1991)
LOUIS C. PAGE (1982)
GLORIA HILL PAPE (2002)
JUBAL RICHARD PARTEN (1993)
ADLAI MCMILLAN PATE JR. (1988)
ANNA J. HARDWICK PENNYBACKER (1939)
HALLY BRYAN PERRY (1966)
NELSON PHILLIPS (1966)
GEORGE WASHINGTON PIERCE (1966)
EDMUND LLOYD PINCOFFS (1991)
BENJAMIN FLOYD PITTINGER
KENNETH S. PITZER
GEORGE FRED POOL (1984)
CHARLES SHIRLEY POTTS (1963)
HERMAN PAUL PRESSLER JR. (1996)
CHARLES NELSON PROTHRO (2000)
HARRY MAYO PROVENCE (1996)
MAURICE EUGENE PURNELL
CHARLES PURYEAR (1940)
CLINTON SIMON QUIN (1956)
COOPER KIRBY RAGAN
HOMER PRICE RAINEY (1985)
CHARLES WILLIAM RAMSDELL (1942)
EDWARD RANDALL (1944)
EDWARD RANDALL JR. (1970)
KATHARINE RISHER RANDALL (1991)
LAURA BALLINGER RANDALL (1955)
JO STEWART RANDEL (2002)
HARRY HUNTT RANSOM (1976)
EMIL C. RASSMAN
FANNIE ELIZABETH RATCHFORD
SAM RAYBURN (1961)
JOHN SAYRES REDDITT (1972)
LAWRENCE JOSEPH RHEA (1946)
WILLIAM ALEXANDER RHEA (1941)
JAMES OTTO RICHARDSON
RUPERT NORVAL RICHARDSON (1987)
JAMES FRED RIPPY
A.W. "DUB" RITER (2003)
SUMMERFIELD G. ROBERTS (1969)
FRENCH MARTEL ROBERTSON (1976)
CURTICE ROSSER
JOHN ELIJAH ROSSER (1960)
JOSEPH ROWE
JAMES EARL RUDDER (1969)
THOMAS J. RUSK
MCGRUDER ELLIS SADLER (1966)
JEFFERSON DAVIS SANDEFER (1940)
MARLIN ELIJAH SANDLIN
HYMAN JUDAH SCHACHTEL (1991)
EDWARD MUEGGE "BUCK"

SCHIWETZ (1985)
VICTOR HUMBERT SCHOFFEL-MAYER (1966)
ARTHUR CARROLL SCOTT (1940)
ELMER SCOTT (1954)
JOHN THADDEUS SCOTT (1955)
WOODROW BRADLEY SEALS (1991)
TOM SEALY (1992)
GEORGE DUBOSE SEARS (1974)
WILLIAM G. SEARS (1997)
ELIAS HOWARD SELLARDS (1960)
WILLIAM DEMPSEY SEYBOLD (2004)
DUDLEY CRAWFORD SHARP
ESTELLE BOUGHTON SHARP (1965)
JAMES LEFTWICH SHEPHERD JR. (1964)
MORRIS SHEPPARD (1941)
JOHN BEN SHEPPERD (1989)
STUART SHERAR (1969)
PRESTON SHIRLEY (1991)
ALLAN SHIVERS (1985)
RALPH HENDERSON SHUFFLER (1975)
RALPH HENDERSON SHUFFLER II (2002)
D.J. SIBLEY (2005)
JOHN DAVID SIMPSON JR.
ALBERT OLIN SINGLETON (1947)
JOSEPH ROYALL SMILEY (1991)
A. FRANK SMITH JR. (1993)
A. FRANK SMITH SR. (1962)
ASHBEL SMITH
FRANK CHESLEY SMITH SR. (1970)
HARLAN J. SMITH (1991)
HENRY SMITH
HENRY NASH SMITH
THOMAS VERNON SMITH (1964)
HARRIET WINGFIELD SMITHER (1955)
ROBERT S. SPARKMAN (1997)
RALPH SPENCE (1994)
JOHN WILLIAM SPIES
TOM DOUGLAS SPIES (1960)
CHARLES C. SPRAGUE (2005)
STEPHEN H. SPURR (1990)
ROBERT WELDON STAYTON (1963)
ZOLLIE C. STEAKLEY (1991)
RALPH WRIGHT STEEN (1980)
IRA KENDRICK STEPHENS (1956)
MARSHALL T. STEVES (2001)
ROBERT GERALD STOREY (1981)
GEORGE WILFORD STUMBERG
HATTON WILLIAM SUMNERS (1962)
JEROME SUPPLE (2004)
ROBERT LEE SUTHERLAND (1976)
HENRY GARDINER SYMONDS (1971)
MARGARET CLOVER SYMONDS (2001)
WILLIS M. TATE (1989)
JAMES U. TEAGUE (1996)
ROBERT EWING THOMASON (1974)
J. CLEO THOMPSON (1974)
BASCOM N. TIMMONS (1987)
LON TINKLE (1980)
CHARLES RUDOLPH TIPS (1976)
MARGARET LYNN BATTS TOBIN (1994)
VIRGIL W. TOPAZIO (1999)
JOHN G. TOWER (1991)
HENRY TRANTHAM (1961)
FRANK EDWARD TRITICO SR. (1993)
ROBERT S. TROTTI (2005)
GEORGE WASHINGTON TRUETT (1944)
RADOSLAV ANDREA TSANOFF (1976)
EDWARD BLOUNT TUCKER (1972)
WILLIAM BUCKHOUT TUTTLE (1954)
FRANK E. VANDIVER (2005)
THOMAS WAYLAND VAUGHAN (1952)
ROBERT ERNEST VINSON (1945)
LESLIE WAGGENER (1951)
AGESILAUS WILSON WALKER JR. (1988)
EVERETT DONALD WALKER (1991)
RUEL C. WALKER
THOMAS OTTO WALTON
FRANK H. WARDLAW (1989)
ALONZO WASSON (1952)
WILLIAM WARD WATKIN (1952)
ROYALL RICHARD WATKINS (1954)
WALTER PRESCOTT WEBB (1963)
HARRY BOYER WEISER (1950)
PETER BOYD WELLS JR. (1991)
ELIZABETH HOWARD WEST (1948)
CLARENCE RAY WHARTON (1941)
JOHN A. WHARTON
WILLIAM H. WHARTON
WILLIAM MORTON WHEELER (1937)
GAIL WHITCOMB (1994)
JAMES LEE WHITCOMB
WILLIAM RICHARDSON WHITE (1977)
C.G. WHITTEN (2001)
WILLIAM MARVIN WHYBURN (1972)
HARRY CAROTHERS WIESS (1948)
DOSSIE MARION WIGGINS (1978)
PLATT K. WIGGINS
DAN C. WILLIAMS (2001)
JACK KENNY WILLIAMS (1982)
ROGER JOHN WILLIAMS (1987)
LOGAN WILSON (1992)
JAMES BUCHANAN WINN JR. (1980)

STUART WOLF (2005)
JAMES RALPH WOOD (1973)
DUDLEY KEZER WOODWARD JR. (1967)
WILLIS RAYMOND WOOLRICH (1977)
BENJAMIN HARRISON WOOTEN (1971)
SAM PAUL WORDEN (1988)
GUS SESSIONS WORTHAM (1976)
LYNDALL FINLEY WORTHAM
FRANK MCREYNOLDS WOZENCRAFT (1993)
FRANK WILSON WOZENCRAFT (1967)
WILLIAM EMBRY WRATHER (1963)
ANDREW JACKSON WRAY (1981)
CHARLES ALLEN WRIGHT (2000)
RALPH WEBSTER YARBOROUGH
RAMSEY YELVINGTON (1972)
HUGH HAMPTON YOUNG (1945)
SAMUEL DOAK YOUNG
STARK YOUNG
HENRY B. ZACHRY (1984)
PAULINE BUTTE ZACHRY (1998)