BRINGING SCIENCE AND ENGINEERING TOGETHER

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The American leadership in science and technology in the 21st Century is being challenged. Excellent research universities have been growing in influence around the globe, especially in China and India. North Korea is training four times the number of engineers on a per capita basis than is the US. The largest automobile manufacturer in the world is no longer General Motors in the US; it is Toyota in Japan. Engineering jobs are now being outsourced to other countries due to a shortage of qualified engineers in the United States. Students and research scientists, who in the past came to the US for advanced training and our world leading facilities, are now able to study and work in their home countries. Most of the research papers now published in the leading physics journal, Physical Review, are foreign, with the largest recent increases coming from Southeast Asia. This is a serious challenge that threatens our economy, our security and our standard of living.

This challenge is documented at length in *Rising Above the Gathering Storm* by the US national academies of science, engineering and medicine. In synopsis, "In a world where advanced knowledge is widespread and low-cost labor is readily available, U.S. advantages in the marketplace and in science and technology have begun to erode. A comprehensive and coordinated federal effort is urgently needed to bolster U.S. competitiveness and pre-eminence in these areas. This congressionally requested report by a pre-eminent committee makes four recommendations along with 20 implementation actions that federal policy-makers should take to create high-quality jobs and focus new science and technology efforts on meeting the nation's needs, especially in the area of clean, affordable energy:

1) Increase America's talent pool by vastly improving K-12 mathematics and science education;
2) Sustain and strengthen the nation's commitment to long-term basic research;
3) Develop, recruit, and retain top students, scientists, and engineers from both the U.S. and abroad; and
4) Ensure that the United States is the premier place in the world for innovation.

Some actions will involve changing existing laws, while others will require financial support that would come from reallocating existing budgets or increasing them." The report is free on the internet and may be found via Google or http://www7.nationalacademies.org/gatheringstorm/. This influential report has been followed by the American Competitiveness Initiative (ACI) that makes specific recommendations to meet this challenge. The recommendations lay out a course of action in education, research and technology.

The new School of Science and Engineering has been structured to respond to this challenge and opportunity by establishing Divisions that mix and merge science and engineering. Our goal is to facilitate the transition from scientific discovery to technological implementation. Lasers were first made to work in the 1960's (the idea had been around for a while before that). Widespread application followed in the 1980's. This spread of decades between scientific development and technological application is typical. By mixing science and engineering at Tulane we hope to reduce significantly this lag time from discovery to application. We also hope to create a learning environment so that students can participate directly in this process of bring new scientific ideas to market. Also we hope to impact on the development of a new New Orleans via our service learning component that requires our undergraduates to participate in education, business and industry in New Orleans.

In the Division of Materials and Physical Sciences we are doing this by first talking about the challenges and possibilities. Scott Cowen and Nick Altiero have been leaders who have meet with the faculty to provide an overall direction and framework. This helps to begin to define what we at Tulane think about when we plan for the future. In our Division we have had a number of faculty meetings and retreats where we have developed a more specific plan for the existing Physics Department and the emerging Division of Physical and Material Science. We strive to see what is needed to give Tulane a unique presence in education and research. In our case we have decided to expand in the field of nano devices, building on our expertise in experimental surface science, polymer physics and low temperature materials as well as theoretical studies in materials properties and existing overlap with research programs in chemistry and engineering. We are currently seeking a new faculty member with outstanding expertise in surface and materials science and plan to seek a computational theorist who can bridge from our expertise in the foundations of density functional theory to development of materials with desired physical and chemical properties. The area of nano technology is one cited in the American Competitiveness Initiative, and now slated by funding agencies for increased support.

In the area of education we are planning to infuse existing science programs with engineering. We have recently announced a new undergraduate degree in Engineering Physics, which will prepare interested students for careers in traditional engineering fields such as mechanical and electrical engineering as well as computer science by providing a strong background in modern physics, including quantum mechanics, so that they will be able to merge understanding with traditional fields such as classical mechanics and electromagnetic theory with emerging fields of quantum information and coherent control. For the degree in Engineering Physics about half of the courses will be in traditional physics and about half in engineering. Practical experience in a related industry or major laboratory is required via the senior project design course. We are currently seeking a person with industrial experience to develop this new course and establish contacts with industry. This person will have faculty status and will participate in the development of all of our degree programs. We expect that some of our future faculty hires in materials science will overlap strongly with the area of materials

engineering. A graduate program in Materials Engineering leading to a PhD in that field is now under discussion.

So we mix science and engineering in both research and education. And we mix practical experience and community outreach with traditional academic teaching. It is in this way that we plan to meet the challenge and opportunities if the 21st Century and play a role in maintaining leadership in science and technology, graduating well prepared students and contributing to an improved global society.