Creativity Key to Good Science

for New CSL Dean

Last August, Russell Betts came to IIT with a clear vision: to make the College of Science and Letters a model of education, discovery, invention, and scholarship within the context of a university with a focus on science and engineering. His background has prepared him for the challenges of his new position as CSL dean: 20 years at Argonne National Laboratory as a physicist and then senior physicist, visiting scientist at Niels Bohr Institute at the University of Copenhagen, assistant professor at Yale University, and university lecturer in nuclear physics at Oxford University. He was most recently a professor of physics and vice provost for planning and programs at the University of Illinois at Chicago (UIC).

The British-born Betts has lived in Chicago for more than 20 years, and appreciates the city on both a personal and professional level. Professionally, he is aware of the exciting partnerships the city affords IIT, including those with Argonne Labs, Chicago Public Schools, and a number of businesses for research, partnership, and student internships and externships. Personally, it gives him, his wife, Katherine, and their two grown children the opportunity to indulge their love of theater, concerts, and other cultural events. Music is especially important to the Betts family: Betts' wife teaches music appreciation at IIT and UIC, and is a musician herself.

IIT's new CSL dean talks about why he came to the university, the role he sees for CSL, and why he thinks creativity is a fundamental principle of science.

Photo: Michael Goss

What drew you to IIT?

As a representative of UIC, I attended President John Anderson's inauguration and was extremely impressed with both him and the interest and commitment of the trustees. In contrast with the University of Illinois, which of course is a large public institution, I liked that IIT is small, private, and very nimble.

What, in particular, interests you about the sciences?

It's a mixture of rigor and practicality. And as I found out later, it involves both sides of the brain. There is a great deal of creativity involved. You are given clues for a problem, and with scientific rigor you can make an inspired guess. It's approaching problems in a holistic way.

What's an example of the intersection of creativity, science, and engineering?

Internet technology, for one. The Internet had its roots in basic science thinking about ways to communicate and share information. It depended on a deep understanding of the properties of materials like silicon and our ability to manipulate its properties in the form of miniaturized electronics used to create digital devices. What amazes me is how quickly this happened.

How will this manifest itself going forward?

It is important to realize that today's quality of life depends in large part on the application of basic science and technology. It was remarked on the bicentennial of the birth of Michael Faraday, a pioneer in the study of electricity and magnetism, that roughly 40 percent of Great Britain's GDP could be directly linked to the application of discoveries he made more than 150 years ago. Thus, we need a continuous investment in basic science, even though the connection to tangible results and to the marketplace is usually unknown at the outset.

The university is currently developing its next strategic plan. What role do you anticipate CSL playing?

I've set up a group to carry out planning exercises for the college. I see CSL playing a vital role, not only in the fundamental disciplines and in interdisciplinary activities, but also through the ways in which we engage our students, our partners, and our collaborators. That obviously carries with it a lot of dimensions. I would hope that CSL can be a model both within the university as a whole and outside IIT.

—Linda Packer

Photo: Michael Goss

Vijay Ramani

It's All Material

Although polymer electrolyte membrane (PEM) fuel cells may eventually power everything from mobile phones to automobiles to unmanned aerial vehicles, they "have always been two to five years away from commercialization," says Vijay Ramani, assistant professor of chemical engineering at IIT. He suggests that the principal obstacles to widespread use of fuel cells—namely fuel storage, durability, and cost—remain key challenges, despite advances over the past decade.

Ramani was recently awarded a National Science Foundation (NSF) 2009 Faculty Early Career Development (CAREER) Award, the highest honor bestowed by the NSF on junior researchers. His prior contributions to the field of fuel cell technology have focused in part on the issue of component durability, with an emphasis on developing a fundamental understanding of the mechanism of electrolyte and electrocatalyst degradation during fuel cell operation. He has used the mechanistic insights he obtained to develop successful mitigation strategies that lower degradation rates by an order of magnitude or more. The CAREER award allows Ramani to prepare and study multi-functional materials for electrochemical energy conversion and adopt an approach designed to boost fuel cell performance and durability, while lowering costs.

"A fuel cell is similar to a battery," Ramani explains, "except that the fuel source and the oxidant source are continuously supplied." Four components must be present at the same place and time for the electrode reactions that sustain the fuel cell. These are hydrogen or oxygen (reactant), protons (reactant or product), electrons (which balance out the protons), and

MORE ONLINE

Fuel cell basics: **www.howstuffworks.com/fuel-cell.htm**
Auto fuel cells interactive website: **www.pbs.org/wgbh/nova/sciencenow/3210/01.html**
Ramani's Polymer Electrolyte Fuel Cell Research Group: **www.chbe.iit.edu/~ramani/index.htm**

a catalyst (usually platinum). Ramani says efficiency is limited in part because good proton transport in the electrode comes at the expense of good oxygen transport, or vice versa. Additionally, the fuel cell operating environment is very complex, with a strong reducing agent—hydrogen on one side (known as the anode), and a strong oxidizing agent, air or oxygen, on the other (the cathode). Sandwiched between these electrodes is the proton exchange membrane, which is fewer than 100 microns thick. The aggressive and corrosive environment created by the interaction of reactants threatens the durability of the membrane. This is further aggravated by common contaminants, including chloride ions and sulfur dioxide.

Through his CAREER award, Ramani will develop a mixed conducting material—one that is able to conduct both protons and electrons on its surface simultaneously. In addition to efficiency improvements, the new material will be superior in its durability. "Not only will it improve performance because you solve the proton-oxygen transport and proton-electron transport tradeoffs, but it can be made of materials that don't corrode," he says, citing potential automotive applications.

While Ramani's success in this endeavor will be a step forward for automotive fuel cells, he stresses that other significant hurdles remain, from the lack of a nationwide hydrogen infrastructure to the as-yet unsolved problems of hydrogen storage.

Ramani is more optimistic about the immediate prospects for smaller, portable fuel cells that could power a vast range of consumer electronics by serving as a substitute for conventional batteries. "Fuel cells are great for niche applications where you can clearly outperform the competing technology in terms of reliability, weight, and volume," Ramani says, noting the successful military and space applications for this technology.

Unlike automotive applications, which require high power outputs, the portable applications require considerably less power, making fuel cells reasonable from a cost perspective. "If you can package the fuel cell right, and it's only going to cost you an extra hundred dollars for a reliable power supply that you don't have to recharge out of the wall, that's great," Ramani says. "That's where the initial markets are going to be."

—Richard Harth

faculty honors & awards

Marshall Brown

Marshall Brown, assistant professor at IIT College of Architecture, has been awarded the prestigious Rotch Travelling Studio Grant. The grant will help to fund a trip for 12 students to Agadir, Morocco, to help strategize the city's Modernist urban core in ways that consider the urban and ecological challenges of current tourism-related coastal development.

Ali Emadi

Ali Emadi, Harris Perlstein Professor of Electrical and Computer Engineering and director of the Electric Power and Power Electronics Center at IIT, has been named a "Chicago Matters" Global Visionary for helping to make Chicago a center for hybrid technology research, development, and application. In its 19th year, "Chicago Matters" is a public-information series broadcast on WBEZ 91.5 FM Chicago Public Radio and WTTW Channel 11.

Frank Lane

Frank Lane, assistant professor in the IIT Institute of Psychology Rehabilitation Counseling Program, is the new president-elect of the American Rehabilitation Counseling Association.

Leon Lederman

Leon Lederman, IIT Pritzker Professor of Physics and the 1988 Nobel Laureate in Physics, is the recipient of the 2009 National Space Grant Distinguished Service Award. The award was established in 2003 to recognize individuals whose life and career have had a long-lasting impact on a science, engineering, or education field that is related to aeronautic, aviation, or space endeavors.

Norman Lederman

Norman Lederman, professor and chair of the Department of Mathematics and Science Education, has been appointed honorary professor in the Department of Mathematics, Science, Social Sciences, and Technology at the Hong Kong Institute of Education. Lederman was also awarded a 2009 Fulbright Fellowship to work at the University of Pretoria and Limpopo University in South Africa this June.

Warren D. Wolfson

Illinois Appellate Court Justice Warren D. Wolfson is the recipient of a lifetime achievement award from the Center for Excellence in Advocacy at Stetson University College of Law. Wolfson is founder and director of the trial advocacy program at IIT Chicago-Kent College of Law and a member of Chicago-Kent's Board of Overseers.

Judith Zawojewski

Judith Zawojewski, associate professor in the Department of Mathematics and Science Education, has been elected to a three-year term on the Board of Directors of the National Council of Teachers of Mathematics.