

# **VISIONS AND VALUES: THE RESEARCH UNIVERSITY IN TRANSITION**

**The 19th Annual Pullias Lecture at the University of  
Southern California**

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California**

I am honored to give this nineteenth Pullias Lecture and delighted to be at the University of Southern California. I have many ties to this institution, dating back to 1957 when I joined the faculty at UCLA. I worked closely with colleagues both in the USC Department of Psychology and in the School of Education. The leadership USC has demonstrated in these fields, then and now, can only be described as outstanding.

I did not know Dr. Pullias. But my scholarly interests, like his, have been in the areas of learning and the educational process. And the purpose of these lectures in his honor--"to add to the ongoing academic dialogue on significant topics in higher and postsecondary education"--could not be more timely. This is an extraordinarily exciting time to be involved in higher education, and especially to be involved with a research university. By the term "research university" I do not simply mean places where intellectual inquiry occurs--under that definition there is no difference between a research university and a think tank. A research university is an institution in which teaching, research, and public service are shaped and bounded by the search for knowledge.

Research universities are particularly exciting places these days because we are living in one of the most productive eras of intellectual discovery in the history of the world. Whether you look at agriculture, medicine, aerospace, biology, computing, or many other fields, there is no question that we are living through a series of revolutions that are remaking our ideas about what is possible. Just last week, for example, a Scottish researcher announced the first successful cloning of an adult animal--a sheep--an accomplishment that had been considered technically out of the question, given current levels of knowledge, until he proved otherwise. Cloning a human being is hardly just around the corner, but this means we are much closer to the possibility than anyone thought--a stunning development with profound and far-reaching implications. The next step in human evolution may well be determined by humans themselves. Many other fields, from astronomy to communications, are experiencing breakthroughs that may be less dramatic but are equally fundamental.

It is not only the content of learning that is changing dramatically. The process of learning, which has not altered significantly in the past several thousand years, is being revolutionized by advances in the cognitive sciences on the one hand and in computing and communications on the other. Developments in the cognitive sciences--neurology, anthropology, linguistics, and similar fields--have brought us closer to understanding the nature of the mind and how it absorbs and retrieves information. These investigations have direct implications for how we conduct the educational process. In computer-assisted instruction, for example, the student's learning history can be used on a moment-to-moment basis to make decisions about instruction. The richness of visual display and the audio capacity of current computers are making computer-assisted instruction a very exciting method of teaching. If you want to get a sense of what this is like, just take a look at some of the computer-based games your children or grandchildren are using. All of them incorporate applications from research laboratories.

Thanks to the Internet, faculty can conduct classes via computer. Students can type in questions and exchange messages with professors via the Internet at any time of day or night, and the whole class can observe the roster of messages--a method of teaching students and faculty alike are finding to be stimulating and enjoyable. And it doesn't matter whether these exchanges are taking place on the same campus or even in the same country. Videoconferencing also erases geographic boundaries. These and other learning technologies are reshaping the process of education with accelerating speed. Education in the early twenty-first century will be heavily reliant on these new technologies.

The explosion of knowledge and the proliferation of tools for learning are forces for change that are coming, in large part, from advances within universities themselves. But there is a third, equally powerful force for change that is arising outside the university. This is the tremendous economic potential of the applications of knowledge--the strawberry hybrid that multiplies yield and is pest resistant, the faster and cheaper computer chip that revives a flagging industry, the new drug that revolutionizes the treatment of disease.

The long tradition of research universities has been to value knowledge for its own sake. However, society's increasing need for applications of knowledge will place new demands on these institutions as we move into the twenty-first century.

California is fortunate to have nine truly outstanding research universities, recognized as such by their election as members of the Association of American Universities, an organization of 60 of the nation's most distinguished public and private research institutions. Three of the

California members are private universities--the University of Southern California, Caltech, and Stanford. The other six are campuses of the University of California, namely, Berkeley, UCLA, San Diego, Santa Barbara, Davis, and Irvine, in the order of their election<sup>2</sup>. The presence of these institutions has been a major reason for California's success in the past. It will be even more significant to California's success in the future.

To explain why these California research universities matter so directly to the welfare of our society, I need to go back to 1945. That was the year in which Vannevar Bush, President Roosevelt's science adviser during World War II, submitted a report to President Truman that was destined to become the cornerstone of postwar science policy.

Noting the impressive contributions universities had made to the war effort, Bush argued that the national interest demanded federal investment in basic research performed in universities, research that would lay the groundwork for new products and processes for industry. This three-way partnership among government, universities, and industry, he was convinced, would guarantee the scientific progress that is "one essential key to our better health, to more jobs, to a higher standard of living and to our cultural progress."

Events have proved him right. And Bush's confidence in the utility of basic research is receiving new validation in the work of a small but increasingly influential group of economists known as "new growth theorists." Their basic argument is nicely summed up in a recent report by the President's Council of Economic Advisors<sup>3</sup>. Fifty percent of American economic growth since World War II, the report states, is due to investments in research and development. Obviously, the private sector is a major driver of that R&D, but federally funded research of universities also plays a key role. As the report points out, when investments in university research increase, there is--with an appropriate time lag--a corresponding increase in private-sector investments. Investments made in R&D today, therefore, will be a dominating factor in the level of economic growth experienced in the future.

Out of the war experience and Bush's visionary energy grew a partnership between universities and the federal government that has become the most productive source of innovation and discovery in the world. This uniquely American idea--that universities should have a role, along with government and industry, in creating and applying the products of research--is one of this country's important contributions to higher education. Other nations around the world have recognized the immense economic advantage research universities represent. Many are seeking to emulate the American model.

No state in the country illustrates the connection between knowledge and wealth with more spectacular success than California. The industries in which California leads the world--agriculture, microelectronics, telecommunications, biotechnology and pharmaceuticals, for example--were born of university-based research. Our highly educated workforce--thanks to California's many fine public and private universities--makes this state a magnet for investment.

Right now California enjoys a combination of advantages that exists here and nowhere else. This state has more high-technology entrepreneurs, more venture capitalists, and more scientists and engineers than anyplace in the world. We have the world's strongest basic research and graduate education. And California has stormed back from the recession of the past five years. The high-technology industries I mentioned a moment ago are leading the state's recovery. All are ripe for innovations that will give California a critical edge if we invest the funds and energy to transform research ideas into commercial products. When you consider California's key position on the Pacific Rim, it all adds up to an important opportunity to shape a strategy for California's economic leadership into the twenty-first century.

Why should California's research universities be involved in developing such a strategy? The short answer is that California and the nation face tremendous problems, from deteriorating inner cities to homelessness to degradation of the environment. These problems can be addressed only if we have substantial economic growth. And, as the work of the new-growth theorists suggests, the successful economies of the future will be knowledge based.

But it is not enough to have universities, and high-technology companies that can use university research, in close proximity. They have to talk to each other. Professor Annalee Saxenian of UC Berkeley has done a fascinating study of the differences between two famous high-technology centers, Route 128 near Boston and Silicon Valley in Northern California. Both have long been renowned for entrepreneurial energy, innovation, and growth, but today Silicon Valley continues to flourish, while Route 128 has lost much of its competitive shine. Professor Saxenian points out that despite their apparent similarities, Silicon Valley has a number of characteristics that account for its continuing economic vitality. One of those characteristics is the energy Bay Area universities have brought to their efforts to connect with industry. Both Stanford and Berkeley sought to increase interactions with industry through such things as industrial affiliates programs, the opportunity for engineers and others to take courses through instructional video networks, invitations to local managers to visit campus laboratories. In

the more formal East Coast environment, Professor Saxenian argues, such interactions were less likely to take place<sup>4</sup>.

The lesson is clear: the bridge to industry is key. Because of its remarkable success in fostering innovation, California is not just leading in many high-technology markets, it is creating them. The openness of our academic and industrial institutions to each other is a powerful competitive advantage that we can and must build on.

At the University of California, we are making a conscious and deliberate effort to organize ourselves to meet the state's growing demand for new ideas and educated people. I would like now to turn to a few of those activities.

The Industry-University Cooperative Research program, established last year at the University of California, is creating new research partnerships between California businesses and UC researchers. Specifically, the program is launching a number of new system-wide matching grant programs that draw California's most economically promising industrial sectors into cooperative projects with UC researchers. These projects are jointly funded by industry and the University to advance fields of science and engineering ranging from health to multimedia and from manufacturing to agriculture. They draw industry into early stages of research to promote innovation and to advance technology transfer. Using research originally done by faculty members at UC Berkeley, for example, a cooperative research project with an industrial consortium developed a high-speed, high-capacity disk technology that can store eight times the information capacity of the Library of Congress. Today, this technology is the foundation of an industry that takes in \$10 billion a year. Many of the firms are located in California and were involved in the original project.

This example is drawn from the University's MICRO program, which became one of the cornerstones of the Industry-University Cooperative Research program because of its fifteen-year record of success in nurturing the development of the microelectronics and computer industry in California. The cooperative research program also includes a new effort, the Strategic Targets for Alliances in Research, known as the STAR Project. The STAR Project is designed to amplify California's leadership in both basic research and commercialization of biotechnology. It emphasizes excellence in basic research and graduate training, and efficient technology transfer. California is already home to one-third of the nation's biotechnology firms and, over the last fifteen years alone, the biotechnology industry has brought California more than 40,000 new jobs with an average annual salary of \$60,000. The STAR Project will help California keep those companies, attract more, and create additional new jobs.

When I talk about the Industry-University Cooperative Research program, I emphasize that the greatest benefit it offers is the involvement of graduate students in every aspect of the research it sponsors. Industry thus gets the benefit of some of the world's brightest young minds. Graduate students gain the opportunity to learn firsthand about industry's needs. As a result, they have an incentive to stay in California and continue contributing their talents to our economy. There is no more powerful form of technology transfer.

The University has long been involved in continuing education to keep professionals abreast of developments in their field, and to retrain people when necessary. University of California Extension is the largest of its kind in the nation, serving nearly 400,000 people a year. In the knowledge-based society we are becoming, lifelong learning is clearly a priority. I have been attempting to move the University towards the expansion of the master's degree in tracks such as engineering and the humanities, especially towards a degree that would be professionally oriented and part time, not one directly comparable to the degree granted to students in the doctoral track. This would provide students with greater flexibility and more opportunities for learning. Another option is off-campus learning centers where regular students could do some of their course work, while non-traditional students could pursue part-time degrees. We are looking at what other universities are doing, what our own experience has been, and how we can strengthen the link between Extension and our full-time faculty. The ultimate outcome will be the weaving of UC's disparate instructional activities into a more nearly seamless web.

There is also much discussion at the University of California about the potential of the new learning technologies I mentioned at the outset of these remarks. We are asking ourselves how we, as a research university, can use technology to enrich and improve the education we give our students. Distance learning, for example, is making it possible for a course offered at Davis to include students at Santa Cruz and UCLA, and faculty from Berkeley or USC or Princeton or indeed anywhere in the world. One experiment involves teaching classes in Russian, Japanese, and Spanish through interactive computers. Students at different locations--in this case, UC Berkeley and UC Davis--can interact with instructors, teaching assistants, and other students using software developed by one of our faculty members. (Students taking Japanese have the opportunity to work with a tutor in Tokyo.) Faculty on our Santa Barbara and Riverside campuses are using video teleconferencing to deliver courses in Religious Studies simultaneously on as many as five campuses. Obviously, if it is possible for campuses to pool resources this way, the potential for sharing among colleges and universities is equally great--and one step towards a solution to the

problem of making higher education more available to the citizens of our knowledge-based society.

One of the most exciting projects we are pursuing is something we call the Cyberlibrary of California. This will be a "virtual" library that can be explored by all with access to the Internet. It will link together digital collections of knowledge and information, not just at UC but across the state and beyond. California's libraries, museums, and archives, public and those of academe, house compelling collections that tell of California's heritage in all its richness and diversity and that are storehouses of accumulated knowledge about science, art, engineering, history, and literature. Collectively, they are among the best in the nation. Creating digital facsimiles of the most important of these collections and enlivening them with multimedia technologies opens exciting new pathways to knowledge, reference materials, and learning for citizens of all ages.

Important starts have already been made. Many of UC's libraries, museums, and archives have digitized parts of their collections and made them available on the Worldwide Web. UC Berkeley, for example, exhibits an annotated overview of photographs of California Indian basketry; UC Santa Barbara shows portions of its extensive collection of maps; and the California Museum of Photography at UC Riverside displays many of its unique collection of photographs.

So far the Cyberlibrary is an idea to be realized. But it is an example of how we can use the technological revolution to educate our youth and provide continuous opportunities for lifelong learning.

I am well aware that these remarks have focused largely--though not exclusively--on the role universities like UC and USC play in the California economy. What about the role of the university as the shaper of character, a critic of values, a guardian of culture? Of course education and scholarship are absolutely critical in the portfolio of university activities, and that needs to be clearly articulated as often and as effectively as possible. My own judgment is that there have been remarkably thoughtful conversations in our universities about improving undergraduate education, for example, and the results have been outstanding. Attention to the quality and content of education is the subject of constant, committed, and vigorous discussion at UC and similar institutions.

But if I have dwelled on the research responsibilities of universities, one reason is to redress an imbalance in our public dialogue about higher education--the dialogue that these Pullias Lectures are dedicated to furthering. Since the days when Senator Proxmire presented Golden Fleece Awards to research projects he considered a waste of public funds, it has been

fashionable to minimize university research as a frivolous and expensive way of subsidizing the curiosity of university faculty. I was director of the National Science Foundation in the late 1970s, when NSF-supported research projects received Golden Fleece Awards regularly.

One of these Golden Fleece Awards went to an NSF study of the sexual behavior of the screw-worm fly. Despite its catchy title, this study was a tremendously important one that led to major advances in biological pest control, including California's ultimate success in dealing with the medfly infestation some years ago. The 1970s were also a time in which university research produced the first successful gene splicing, a joint UCSF-Stanford breakthrough which led to the current historic efforts to map the human genome. A UC astronomer designed a telescope so powerful that it is giving us clues about the first moments of our universe. UC scientists developed Magnetic Resonance Imaging, a wonderful diagnostic tool that allows doctors to examine tissues of the body without making an incision. And these are only three examples from two California universities. Looking back over the period, there can be no question that university research was critical to the future of the nation in many different dimensions. It still is.

I want to emphasize that the value of university research is not limited to the sciences. *Habits of the Heart*, a groundbreaking study of individualism and community in American life that came out of UC Berkeley, is just one instance of university research in the social sciences that has shaped our public discussion of the values that animate our society. The Humanities Research Institute, located at UC Irvine, has been an important voice in the dialogue about the humanities and their contributions to our culture and our daily lives. In each case the fact that these activities unfolded in an institution with research as a central mission has been essential to their nature and impact.

The good news is that, in my judgment at least, the importance of research universities to our society is becoming increasingly clear to government at all levels and to the citizenry at large. There is no doubt in my mind that states and nations that expect to prosper in the future will need to do what we are trying to do here in California--dismantle some of the barriers that impede the flow of innovation from universities to our economy, whether the barriers are impediments to cooperation between campuses and companies, inadequate access to education, or insufficient opportunities for lifelong learning.

We need to have a passionate conversation about higher education in California. This conversation should encompass more than just the role of research universities in economic growth (though that remains a critical topic for California). But this conversation should also recognize that the discovery

and application of knowledge are not at the periphery but at the heart of what research universities are all about. To remind Californians of that fact is not to devalue any other mission of the university. It is simply truth in advertising.

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<sup>1</sup>UCLA is the birthplace of the Internet, having created the first node on the information superhighway in 1969.

<sup>2</sup>California, with nine institutions, leads the nation in the number of AAU members; New York is second with six AAU universities; Pennsylvania and Massachusetts have four, Illinois three. Nine states have two AAU members, fifteen states and the District of Columbia have one and twenty-one have none.

<sup>3</sup>"Supporting Research and Development to Promote Economic Growth: The Federal Government's Role," The Council of Economic Advisers, October 1995.

<sup>4</sup>Annalee Saxenian, *Regional Advantage* (Harvard University Press, 1994).