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STUDENT CONFERENCE
President Robert C. Dynes
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**Keynote Address:
“My Life In Physics: A Long, Strange Trip (And It Ain’t Over)”**

Introduction: Four Snapshots

I’m really delighted to be here today. I apologize for having juggled my schedule around. But the governor of California called and said he wanted to tour the Berkeley lab, and I do not pass up an opportunity like that to educate the governor on the value of science and education for the economy of California.

Congratulations to the organizers of this conference, to Kyler and Tom and everyone else who was very much involved, including some of my colleagues at UC San Diego. This is a great idea, so great that I got up early this morning and flew Southwest Airlines to get down here. I want to have a discussion with you. I do want to hear from you. This is a critical time in the United States for science and education.

When I received this invitation to give this talk, my mind went back 40 years – most of you were not even born – to when I was a graduate student at McMaster University in Hamilton, Ontario, Canada. I was thinking about the trip that I’ve taken since 1964 and about how unpredictable it has been. I want to talk about that today. It’s been a really strange trip from really cold weather in Ontario to landing just a few miles from the Mexican border to overseeing probably the largest public university in the world.

I’ve been driven by a passion for physics very much since the beginning. I wrote my first paper in 1964 – you can still find it, it’s in the Canadian Journal of Physics – it was published in 1966, so it’s 40 years old, and it’s still relevant today. I still use what I learned in that paper about superconductivity, and it has more insight than I thought I had at the time. I’ve never lost my passion for physics. I’m enormously proud to be a professor of physics at one of the premier universities in the world. When I introduce myself, I always say that I’m a professor of physics at UC and the president of the university.

I do have a job that I never could have possibly imagined. Along the way over 40 years, I have seen seismic changes in education, in research, in science and technology, in social movements and in global relationships. And I don’t see any sign that these changes are slowing down. What I’m suggesting to those of you who are physicists, if you’re looking forward to change, put your seat belts on, it’s going to be one hell of a ride. You’re going to be living a life of change whatever you end up doing.

So let me give you four snapshots from different points. The first was my decision to go to Bell Labs when I was a graduate student. The second was my decision to go from Bell

Labs to a faculty position at UC San Diego and what drove that decision. The third snapshot is my last year as the chancellor here at UC San Diego; it was a tumultuous period in world history. The fourth snapshot is my current job, my life as the president of the University of California.

First Snapshot: From McMaster to Bell Labs

Like most Canadian kids, I grew up wanting to play professional hockey. I played Junior A hockey, and I was good. I played against people like Bobby Orr – he was a lot better – and I had a contract with the Toronto Maple Leafs. But instead, I went to college in my hometown, to the University of Western Ontario because I couldn't afford to move away from home. I worked in the summers on highway crews and in a dairy and in an insurance company. This will tell you how old I am: the insurance company was introducing computers to its business, and it was my job to check the calculations of the computer by hand using mechanical calculus.

In my junior year, my department chair told me that I should go to graduate school, and I didn't really know what graduate school was about. I went home and said to my mother, "I want to go to graduate school," and she looked at me sadly and said, "Why don't you want to get a job?" To the day she died, I don't think she ever really understood what I did for a living. My father was heartbroken because he wanted me to play hockey. That's the environment I was in.

So I went to McMaster, and I'll never forget the day – some of you have probably experienced this, and some of you have it to look forward to – I was walking home after doing an experiment, it was February and it was really cold, and I realized that the experiment revealed something that nobody else in the world knew. It's an exhilarating feeling, and I've had that feeling many times since. That day, the fire was turned on. That day, I became a physicist. If you've experienced it, you know what I'm talking about. If you haven't experienced it, look out for it.

I graduated in 1968, and I had an option to be a postdoc at Cambridge – a lot of Canadians went to Cambridge – or I could go to Harvard or to Bell Laboratories. When the opportunity came to go to Bell Labs, I took it in a heartbeat. At that time, it was a mecca, it was the most exciting laboratory in the world. I was a 25-year-old snot-nosed kid entering the U.S., and I was nervous. The U.S. was always looked upon as the behemoth, the muscular thousand-pound gorilla. Are there Canadians in the audience? Then you know what I'm talking about. Are there Mexicans in the audience? Then you know what I'm talking about, you understand. And it was 1968, so the U.S. was in the middle of the Vietnam War, and I was 25 years old. For anyone who would like to see it, I still carry my draft card in my wallet.

I was lucky to go to Bell Labs. I would walk down the hall and see all these famous names on the wall. No one cared whether you were a physicist, a chemist, a biologist, an electrical engineer, an economist, or a psychologist. It was what you did that counted. I was hired in 1968, and within two or three years, there was a whole cadre of people hired.

Five of my colleagues and friends eventually won Nobel Prizes. That's the kind of environment it was. I met people like Max Mathews, the father of digital music. I remember when he gave a talk on digital music and we all thought he was nuts. Max is now at Stanford. I met Saul Sternberg, who is now one of the leaders in optical perception. He's now at the University of Pennsylvania. I remember when computer science sprung out of physics and electrical engineering. No one cared if you had a degree in physics, chemistry, material science or mathematics. We cared about what we could learn from each other. It was an exciting time.

Second Snapshot: From Bell Labs to UC San Diego

Now let me fast forward 22 years. A lot of things had happened in industry in the United States from the '60s to the '90s. Industry was still exciting, but it was very different. The excitement in the industry was in startups, in creating new things, in being innovative. There was a small company just down the street from the Berkeley campus called Pixar, which is a group of computer science geeks that sprung out of Berkeley. Gone were the traditional Bell Labs and IBM Labs and General Electric and Xerox and RCA. RCA had a lab. You've probably never heard of RCA.

I was in management at Bell Laboratories. After about 22 years, I knew it was time to go. I chose to move from what I thought was the waning light of industry research – to academia. On a personal note, I was the director of a laboratory, and my boss, who shall remain unnamed, told me, "Bob, you're doing a great job, the only criticism we have of you is that you are too much of a consensus builder." And so it was time to go. I had learned years and years earlier, actually at the ice cream factory where I worked, that leadership is not telling people where to go. Leadership is building a consensus in the direction that you want to go. Leadership is having everybody want to go in the same direction that you want to go.

So I went to UCSD, which was and is a marvelous place. I remember very early on when I was building my laboratory on the fourth floor of Mayer Hall, and I met a person in the Chemistry Department who had joined UCSD a few years earlier from an older traditional university that will remain unnamed, and he said, "Let me tell you the difference between UCSD and that other university. When I was at the other university, and I said, 'I want to do this,' people said, 'No, no, you can't do that, that's Dr. X's area and you can't go into that area.' Whereas at UCSD, it was, 'Oh, you want to do that? Why don't you go over and see Dr. X? The two of you could probably do something pretty fabulous.'" It was a different attitude, and I found it exciting. It was the environment I wanted to be in.

There were two things that really struck me when I moved to academia. I was sitting at my desk one day, and I had a revelation: I don't have a boss! Hallelujah! I had to raise money, and my real challenge was to get funding support for my research. But I didn't have a boss anymore. That was the first revelation. The second was that I realized that I was motivated by something that was more global. The university's mission is really threefold: education, research, and public service. The way I translate it is: creating new

knowledge, creating the creators of new knowledge, and then taking that new knowledge to society. It's a much loftier goal in my view than making money. I got turned on by it, and I became really excited by this.

While I was at the university, I saw the continuation of something I had seen earlier, which was a huge shift in support from the physical sciences to the life sciences. A lot of physicists had great difficulty with that. I didn't. I am in Washington a lot arguing for support for the physical sciences, because ultimately, the mother science is physics, and it will continue to be the mother science. The evolution of physicists into everything is really healthy. And so as physics has had an impact in the life sciences, we are seeing an explosion of the biological sciences because we're finally putting quantitative science into the stamp collecting of life. It really is what physics does. We've launched fields like computer science, electrical engineering, bioengineering, and material science. And we will continue to launch fields.

You should not feel nervous about the flow of support from the physical sciences to the life sciences. Leave that to me to worry about in Washington. You should look upon the opportunities to use the physics that you've learned in as broad a way as possible. Believe it or not, I use my physics training in thinking about how to run the University of California. You ask different questions than other people. You look at data, you think about statistical significance, you think about critical variables in running the University of California. So your physics training will carry with you for the rest of your life.

Third Snapshot: Final Years as UCSD Chancellor

Let me go to the third snapshot, to the year 2002 and my life as chancellor of UC San Diego. I started that job in 1996. I only really had five or six years of peace as a professor of physics before I took on administrative jobs. The world was changing. The world always is changing, but the world was really changing at that point. On the national scale, the Council on Competitiveness was thinking about how the U.S. could stay internationally competitive and about the relationship between academia and industry. The traditional industries were becoming unable to compete with their own research laboratories. The responsibility of generating new basic intellectual knowledge was shifting even further to the universities. And San Diego turned out to be a model case because of the relationship between UCSD and local industries: the wireless industry, the software industry, and the biotech industry.

Then, of course, after 9/11, all hell broke loose. It changed forever, in my opinion, the relationship between universities and industry. For me, it spelled the end of what I knew traditionally as R&D. As we watched what happened, we realized that there were lots and lots of technology that was never in the hands of the first-responders. We had wildfires here in San Diego, and firefighters were scurrying about trying to fight the fires, and they couldn't communicate with each other because their cell phones were jammed. And I realized that we, as scientists, really had to think of R, D, & D – research, development, and delivery. R&D just doesn't cut it anymore. If we can't deliver the health care breakthroughs and the nanotechnologies to society's benefit, we're not going to be

supported, and we're not going to meet what I view as part of our mission which is bettering society.

So I saw a real change at that point. And I talk about that change a lot. I'm thinking through better ways beyond what we do now to transfer intellectual property from the academic environment to better society. It's an interesting case, as you can well imagine, because there are a lot of greedy people along the way, both in the university and outside the university. And so, it's interesting to think about how we can actually transfer what we've learned. We know how to transfer people – that's you. But we have to think about how to transfer intellectual property in the most effective way.

Another thing happened at 9/11. This nation, the United States, took several steps backward. I joined with colleagues across the country to speak out against two U.S. policies. The first is restricting publications. It's called "sensitive but unclassified" data. The discussion at the time was a little bit like pornography: We don't know what it is, but when we see it, we'll know what it is. It was the same way with data: We don't know what sensitive data is, but when we see it, we'll know what it is. And if you've published it, you've broken the law. That puts scientists in a really bad position. So we've been arguing very vehemently that open scientific communication is the best avenue for national security. Now, there are certain things that have to be classified. When you classify something, you put a fence around it, and everything else is open to scientific communication.

The second national position which we've been fighting against is the relationship with the rest of the world: immigration policies and the flow of people. As a lot of you know, it is much more difficult now for students to come here from other nations. How many are here in the U.S. from other nations? I'm really pleased to see that. About two or three years ago, the White House wanted to close the borders. We've been fighting this ever since. I remember a watershed day when the then-Secretary for Homeland Security, Tom Ridge, finally agreed with us that the biggest threat to U.S. security was closing the borders. He finally got that, but it was a battle royal.

Just before I left two years ago to come up to the Office of the President, one of the things I'm most proud of is that we managed to recruit Mario Molina to UC San Diego. Mario was at MIT. He was a student at Irvine, a student of Sherry Rowland, with whom he shared the Nobel Prize in Chemistry in 1995. I think he's the only scientifically active Mexican Nobel Laureate. My view was that if we could recruit Mario to UC San Diego, he could work in an interactive, collaborative way in San Diego and Mexico on the things that he's most interested in, which are environmental sciences and air and water quality. Since that time, we've written agreements with several Mexican universities on the environmental sciences, and he's heading that up.

Fourth Snapshot: First Year as UC President

Finally, the fourth snapshot, the University of California: 200,000 students – I'm telling you this because I want you to see how frightening this job is – 200,000 students, 10

campuses, three national laboratories, eight hospitals, and the budget of the university is \$19 billion. If I look like a deer in the headlights sometimes, it's because I am. There's just too much to know and not enough time.

When I took this job, there were (and still are) enormous pressures to increase the undergraduate population. Virtually every family in California wants their child to go to the University of California. And there's a lot of screaming as to why they can't. So I am constantly in debate about quantity vs. quality. I will not compromise the latter. During that time of pressure for increasing the undergraduate rolls, our budget went down, and the budget for graduate programs did not go up, as some of you undoubtedly know.

So why did I take the job? I was fat, dumb, and lazy in San Diego. I had a great lab. Science was good to me; I'm a member of the National Academy of Sciences, I've won a couple of international prizes. I didn't ask for the job. The Regents came and twisted my arm. I really went through this thought process. I've been extremely happy as a scientist, and I'm still happy as a scientist. I can solve a lot of problems; I can come up with a new concept, with a new material. But the thought of being able to influence the state of California in a fundamental way was just too intoxicating. The thought of being able to affect hundreds of thousands of people's lives is just too much.

I've been treated well over the past 40 years as a scientist. When I've really needed money, I've gone to the NSF, the DOE, the Air Force, and the Navy, and I've gotten it. Now, it's not easy, let me not mislead you. I've sometimes taken two or three runs or bites of the apple. But I've gotten it. I've been supported, and I've had a great time. And I think that because I've been so well treated, I owe society back. And I want to pay it back.

Since I took this job, I have traveled all over the state – you wouldn't believe how big this state is – I've listened to teachers, entrepreneurs, CEOs, patients in hospitals, farmers, students, people on welfare. The impact that the University of California has on Californians is enormous. It affects everybody's life in California, and a lot of people in the rest of the world.

Last month, I toured a 63-year-old wholesale nursery in Half Moon Bay, one of the nation's leading producers of ornamental plants. It's a family-owned business, and it's huge; they employ about 800 employees, and they have plants in Half Moon Bay, in Florida, and in Hong Kong. The owner, Jack Pearlstein, said that their economic survival depends upon his ability to tap into the latest research findings of the University of California. Jack depends enormously on understanding water and irrigation, climate and pest control, plant propagation, water factors, all sorts of factors that keep him competitive. And his competitive advantage is the UC. He said, quite simply, "Without your science, we're through. Without science, California would no longer be an agricultural state." Another person, Henry Samueli, who founded Broadcom, was in Sacramento talking about the University of California, and he said, "If it weren't for UC, my company would be in Massachusetts." So this job is sometimes worth it.

Conclusion: Four Lessons Learned

Let me make one last comment about lessons I've learned. I'm sure I've exceeded my time limit, so let me give you four lessons.

First, to quote Yogi Berra, when you come to a fork in the road, take it. Don't agonize over decisions. Think about them, look at the options, but don't be mesmerized by making the decision. Make the decision, and be confident that you have chosen the right path, because you'll make it the right path. You are not an innocent bystander in your life. Whichever path you choose, you will make it a successful one. Don't ever look back and think, "Should I have chosen the other path?"

Second, take to heart what I suggested earlier about taking your physics and preaching the gospel. Don't stay in the area that you've studied. To cite one example, UC campuses are teaming up to form new institutes. There's one in the Bay Area called the Institute for Quantitative Biomedical Research or QB3. It teams up UC San Francisco, UC Berkeley, UC Santa Cruz, and the Berkeley Laboratory. It brings together biologists, engineers, physical scientists, and computer scientists, and it integrates the life sciences and the physical sciences, computer science and informatics in a way that there is no other place in the world with as much horsepower just because of the blend. There are physicists in the middle working on neural networks and how the brain works and imaging. If I were a student now, I'd be looking at institutes like that. You've got to learn physics first; you've got to have the right stuff. But take it and start talking with other people and learning what the really important problems are out there.

Third, you didn't become a physicist in a vacuum. Somebody turned you on. Somebody taught you well. You owe something to the next generation; you must transfer what you've learned to the next generation. I just launched a California Teach program which has committed to generating a thousand science and math teachers a year. It's been so easy to convince everybody: the governor, industry, the legislature, even some of the faculty. But you know, the toughest people to convince have been physicists. And this is really an indictment of ourselves. It involves a very personal story. My wife is also a physicist, and she had a student who decided after her master's degree that she wanted to teach high school science. And the physics community then discredited her: she was no longer "doing physics," she was no longer part of the respected profession. Please don't think like that. A teacher who instills a scientific fire in young people's hearts is "doing physics."

Finally, and most importantly, take some risks. Now, that's a buzz word. Management consultants always say, "Take risks," and I'm constantly reminding management consultants that taking risks means sometimes you fail. And you've got to accept that. California is so nice because in California, failing at a business is a badge of honor. If you fail at a business in California, it's basically, "OK, what are you going to do next?" So take risks. I've always thought of myself as a conservative person, and my wife just laughs at that. She says, "Are you kidding?" and she goes back over the things that I've done, and she's right. I've taken a lot of risks. I had a technician at Bell Laboratories for

20 years who told me, “You try lots and lots of different things, and your skill is knowing when to bail out.” Take risks, because when they work out, it’s incredible. And you’re smarter than most people, you wouldn’t be here, you wouldn’t be physicists if you weren’t smarter than most people. Take risks, and recognize when to bail out.

Today, I look at you, and I think, “Geez, I wish I was your age.” You’re going to have a hell of a ride, and I hope you enjoy it.

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