

Liberal Arts Education and American Science

John Kuriyan

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John Kuriyan is Professor of Molecular and Cell Biology and of Chemistry at the University of California, Berkeley and a 1981 graduate of Juniata College.

Members of the Class of 2014, President Troha, members of the Board of Trustees, faculty, parents, family and friends:

It is a very special honor for me to be here on this stage today. I was very lucky on a May morning thirty-three years ago to have been part of the 1981 graduating class, sitting then where this class sits now, waiting to receive our degrees from the president, Frederick Binder. President Binder had his leg in a cast due to an accident, and he sat enthroned regally on the stage throughout the ceremony. I would not wish a broken leg on our spry President Troha, but there was a special pomp to the ceremony in 1981 as the graduates all bowed in turn before President Binder's throne. It was the same bright Pennsylvania spring, with the grass and the trees glowing in the shade of deep green that I miss in California.

I am grateful for the scholarship that brought me to Juniata, for my family that made possible the long trip from India, and for the support of the Juniata community and my host family. Each of you in the Class of 2014 is likewise grateful, I am sure, to your family, and for the financial help that many of you have received from Juniata. So, join me in a cheer for the families of the graduates, first for all of you from my adopted home state of Pennsylvania, for no institution achieves greatness that is not built on the bedrock of its own community. And a cheer for all the families and friends from the rest of the United States, particularly the Golden State of California (you know who you are!), for recognizing the gem of a college that is here on the banks of the Juniata River. And let us cheer the friends and families of students who have come from abroad to study here at Juniata, from Europe and from as far away as China, Brazil, Indonesia, Myanmar, Nigeria, Vietnam, Thailand, and Korea.

And now, a resounding cheer for the Class of 2014: May success attend your every endeavor! I'd like to especially recognize students who have chosen to study the disciplines that most impacted me during my stay at Juniata. Will all the students with POEs in chemistry and biochemistry please rise — we know you are here, so don't hide! May the power of the molecular orbitals and the Boltzmann distribution be with you on your journey forwards! And I'd like to call on graduates in English, theater and communications to rise also. The most important lesson I have taken away from Juniata professors,

like the late Esther Doyle, is that if you can get another person to understand what it is that you are actually saying, you are well on the way towards friendship and alliance.

And to the other students in the graduating class I say that the liberal arts tradition binds you all in an intellectual unity that embraces integration over narrow specialization. A Juniata education is a privilege, one that in an international context is most unusual in the flexibility that it has afforded you in crafting your own programs of emphasis. In India, and indeed in much of the rest of the world, one's course of study is completely prescribed, even down to the last lecture hour. Are you an English literature major who yearns for the excitement in genomics? Forbidden! Are you a physicist with a yen for the Romantic poets? No Keats for you! Such narrowness is unthinkable at Juniata.

When I began graduate school, I met with one of my professors, and after an exciting conversation in which she described the frontiers of research, the professor told me that as a graduate teaching assistant one of my principal tasks would be to ensure that the undergraduates did not disturb the faculty. This came as a shock to me, fresh from Juniata, where my usual reaction upon confronting a malfunctioning instrument in the lab at 8 PM would be to call Tom Fisher or Bill Russey or Ruth Reed or Paul Schettler, not mindful of whether they had a life of their own. The students not disturb the faculty? Unthinkable at Juniata!

Years later, when a professor myself, a colleague I was teaching a class with posed a question in an exam that seemed bizarre to me. When pressed, my colleague responded that only students who had actually taken the class would be able to answer the question. A professor exerting considerable ingenuity to discern whether the students taking the test were actually his own students? No doubt this anticipates the world of tomorrow, in which all courses will be massively online, but it is still unthinkable at Juniata.

The features that make a Juniata education so different from that at a large research university are, of course, characteristic of the best liberal arts colleges in America. And the best aspects of the American liberal arts tradition are mirrored in the deepest strengths of the American scientific enterprise, which has been a model for the world since the end of World War II. Yet today, many scientists are worried that this period has ended, and that American science is in decline and in danger of losing a generation of our most gifted students. But this malaise can be overcome by building on our core strengths, which are the same core strengths we should seek to preserve at Juniata.

The first of these strengths is an emphasis on the individual above all organizational and political structures. American science has been built on curiosity-driven research propelled by individual initiative, from which the greatest breakthroughs have emerged. I am myself witnessing one such breakthrough right now, in the work of my colleague Jennifer Doudna at Berkeley.

Jennifer, a graduate of another small liberal arts college, Pomona in California, has discovered a way to very easily engineer human genomes by modifying an obscure defense mechanism employed by

some bacteria to protect themselves against attack by small viruses called phages. There are perhaps more than 100 million distinct species of phage on our planet, invisible packets of DNA that are the most abundant life forms on earth. Their ferocity towards bacteria has led to the evolution of a countermeasure strategy in which the bacteria use information in the phage DNA to chop up the genetic information of the invading phage. By modifying this molecular jujutsu system known as CRISPR, Jennifer and her colleagues have set off a revolution in genetic engineering, which will increase enormously the speed with which mammalian genomes, including human genomes, can be engineered. Compare Kitty Hawk to a jet plane.

All this came from Jennifer's singular initiative in studying an obscure antiviral mechanism in bacteria, and it will lead the way to novel therapeutics for diseases like cancer, Parkinson's, and diabetes. A little thought will tell you, however, that the ethical implications of this emerging power are scary. Weighing the implications of these kinds of advances for all aspects of society will challenge our critical thinking. Those well educated in the liberal arts have a key role to play in ensuring that the way forward increases our humanity rather than decreasing it.

The second great strength of American science is its internationalism. This is not simply a tolerance for foreigners working in American labs, but the complete embrace of the outsider, so that after you open your first test tube in an American research lab you are an American scientist and not a foreign one. I was recently in touch with Milton Taylor, a 1980 Juniata graduate in psychology, who has since been teaching in many countries around the world, and I asked him for suggestions as to what I could tell you today. Milton pointed me to an article he had read in the *New York Times* last month about a young Stanford physics professor named Manu Prakash, who has been inventing ultra-cheap scientific instruments, such as a microscope built of paper that can be assembled for about a dollar. It is Prakash's dream that such instruments will, in the hands of the poorest people in the world, help diagnose and prevent disease. I learnt from Prakash himself about what I think is the most creative of his inventions, which I call "Shazam for mosquitoes," a smart phone app that, like the popular music recognition software Shazam, is able to tell you whether a mosquito buzzing near you is a harmless species or whether it could be a carrier for a deadly disease. Prakash recognized that each species of mosquito apparently buzzes its own tune, one that can be recognized by his app. As the *New York Times* told us, Prakash is here because an American professor recognized his talent when visiting India and recruited him, and he is now part of the American scientific engine, for the benefit of the world.

The third great strength of American science is the extent to which philanthropy has nourished basic scientific inquiry. While the federal government remains the central pillar on which the scientific enterprise is built, America is unique in the world for the extensive role that private philanthropy has played in supporting science. Private philanthropy gives us the freedom to explore nature without

worrying too much about immediate reward. Both Jennifer Doudna and I are supported primarily by the Howard Hughes Medical Institute, created by the vision of the legendary aviator.

I wish you well, Juniata Class of 2014. You are entering a world that is far more competitive than the one that my class entered, because of the end of the cold war and the remarkable advances in the economies of so many countries around the world. Take with you the individualism and creativity that Juniata has surely nourished in you, and give back to society through service and philanthropy, and we will prosper together into the next century. Congratulations!