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Good evening. I am delighted to join Dean Boyer and my faculty colleagues in welcoming you to the University of Chicago.

This is now your university. You chose wisely when you decided to join us here. I do not know what most influenced your decision. People attend college for a variety of reasons. To please their parents, to take a first step toward medical school or investment banking, to get away from home, to make new friends and join valuable networks.

But you are now with us and the important questions for today are: “What do we expect of you, and what might you expect of us?” This leads to the title of my address: The Aims of Education. I will speak about Chicago values and our people, and invite you to consider my view of education at Chicago.

I start with the observation that throughout our history we have held the importance of research and discovery as a defining value. In the words of our former president Edward Levi, “The essential purpose of the university ... [is] to discover what we can of the nature of man and the universe.” Our mission is to shed light, and this extends to the most basic questions: how did the universe begin, how did life begin, how does life pass from generation to generation, what are the forces that govern the material world, what of laws, and the role of collective action, what are the finest expressions of our humanity and how can we create more of these, how should we consider our responsibilities to one another? Chicago faculty have had an outsized influence on the many ways these questions have been answered: from Enrico Fermi and the first controlled nuclear pile to the novels of Saul Bellow, from Gary Becker’s focus on investments in human capital to the contemporary music of Augusta Read Thomas. This is a place that aimed high from the time that it was founded, and that has lived up to its lofty ambitions.

However, the purpose of this lecture is to speak about a Chicago education. Many universities speak in vague and pious ways about the connection between research and undergraduate education. At Chicago this connection is genuine and the result of thoughtful consideration. The nature of this connection and its consequences demand exploration.

I will argue today that this connection has served our students well, and to accomplish this objective, I will do more than list some of the many people who studied in the College and went on to make substantial contributions to society. However, such a brag list is not a bad place to start and so I will list a few of them:

Katherine Graham was responsible for the business success of the Washington Post, which she

led during the period of Watergate. Her autobiography won the Pulitzer Prize. It is the first of several books that I will recommend to you. Paul Samuelson was the most influential economist of the second half of the 20th century. He had a profound impact on both economic theory and policy. James Dewey Watson, who with Francis Crick discovered the DNA double helix, was arguably the most influential American biologist of the 20th century. Saul Bellow, this country's foremost novelist in the second half of the past century, also studied in the College.

But a brag list is not enough. The big question that I put before you this evening is the following: This is a place that from its birth has defined itself in terms of "research and discovery." A place that is obsessed with making contributions that are at the forefront of knowledge. And these are almost by necessity the work of its faculty. So how is it that our undergraduate arm, the College, has been so very successful in paving the way for the remarkable achievements of a Paul Samuelson and a James Dewey Watson?

Of course I have loaded the dice. It is highly likely that the four individuals I have just cited came to Chicago with much of the stuff that was responsible for their subsequent success. They likely arrived here with considerable discipline and ambition, curiosity, and enormous talent, even if not yet fully discovered. Perhaps the best that we can claim is that we did no harm. But we are justified to claim more. I will argue that the environment we have created, an environment in which discovery and investigation come first, can be particularly nourishing, especially when you understand and embrace that environment.

I will tell you "stories" about learning, teaching, and discovering, and use these experiences to provide some modest guidance for how to best navigate what lies ahead for you in the College. This is also my first step towards a theory that explains our success in integrating education with learning and discovery at Chicago.

The first story concerns a teacher and his student, both of them writers. You may be familiar with the film *A River Runs Through It*, which starred Brad Pitt, and on a superficial level is about fishing in Montana. The movie is based on a novella by Norman Maclean, who taught English in the College. But Maclean's masterpiece, at least to my mind, is the soaring *Young Men and Fire*, which was published posthumously. It is Number 2 and perhaps my favorite on your (optional) reading list.

Maclean taught Shakespeare and it is reported that every year he said to himself, "You better teach this bastard so you don't forget what great writing is like." Maclean had very high standards, both for others and for himself. He did not write a book until after his retirement. How are you to feel when you measure your abilities relative to the Bard? And how is a second year in the College to feel, when she has the impulse to write and is instead forced by Maclean to criticize Victorian poetry, spending hours dissecting just one line? The distinguished poet and novelist Susan Fromberg Schaeffer writes that her experience studying with Maclean was: "...a collision of personalities.....my behavior was reprehensible. I would always arrive in the middle of the class, after the quiz. I wonder if this wasn't a case of two people who wanted to write, and who were not writing--grating on one another's nerves." But Fromberg Schaeffer continues by saying that Maclean had reserves of patience, and -- another quote -- "(we were) allowed to find our own way, not to be yanked by the ear and told that you must immediately do what someone else knew was the wisest for you." And she then adds the special wisdom, "Because even if they were right -- especially if they were right -- you couldn't have seen it, so you would have been forced into rebellion. That breeds a kind of bitterness, and in a very short time the bitterness becomes automatic."

Like Fromberg Schaeffer you will be encouraged to find your own way. We believe in your potential. We understand that you are young, that you have lessons to learn, technique to develop, and perhaps entire areas of learning to experience for the first time. There may be important music that you have never heard, mathematics that you have never imagined, and cultural perspectives that are foreign.

We can help you take some first steps in these and other directions. We can help you open some of these doors. But the precious qualities that you bring to the table are curiosity, the “urge to know,” your own particular talents, and your drive to be creative. What will be your own form of investigation? Where are you prepared to challenge the best of what has come before? We will not present you with a formula for creativity; indeed, we struggle with this ourselves on a daily basis. But you should expect us to help you to master technique and to think carefully about the best that has come before. You should expect high standards, and for us not to get in the way. Our job is to help you to find your own way. This involves directing attention to the important questions, as opposed to giving you answers. It means encouraging “the urge to know.”

Fromberg Schaeffer’s words were taken from a book titled *An Unsentimental Education*, with the subtitle *Writers and Chicago*. It is number three on the reading list. In it you will find essays and interviews by writers who have been touched by Chicago: Novelists, poets, editors, essayists, critics. Some of them will be well-known to you; for example, Bellow, Philip Roth, and Kurt Vonnegut. They explore their relationships with teachers and ponder the usefulness of their academic education. They consider the role of the teacher.

A common thread is that they were taught to think, as opposed to being taught what to think. As Susan Sontag put it, “We were taught to be reasoners. ... We were expected not to ‘answer’ a question, but to present an argument. ... When questioned you were expected to defend your argument with precision.” That is what you deserve and what you should expect. Whether in literature and the arts, science, or the social sciences, you and we must create arguments and defend them with precision. This is my life and it is yours for the next four years. And it is an important part of how we connect research and discovery with education at Chicago.

How valuable is it to learn how to think, analyze, and sharpen the expression of one’s ideas? Does the emphasis that we place on thought and curiosity suggest that Chicago is about thinking rather than doing? Does the importance of what we do here extend beyond the classroom? Might the substantial pride that we take in the fact that many graduates of the College continue to graduate school and earn the Ph.D. mean that we are a “boot camp” for academia? The answer is no.

I began by citing our former undergraduates Saul Bellow, Katherine Graham, Paul Samuelson, and James Dewey Watson. While it is true that two of them went on to the Ph.D., it is significant to note that all of them had more influence beyond academe than within. One must not underestimate the power of curiosity and ideas to change the world. The importance of the companies and technologies that spring from understanding the double helix rivals that of the internet. Watson’s discoveries have had a profound influence on medicine and the treatments that are available to us. Samuelson changed the “practice” of economics, both within academia and beyond. He made it a good deal more rigorous and mathematical. The advent of quants in finance, for the good and for the bad, was accelerated by years because of his work alone. Bellow through his novels and Graham through her leadership of a publishing empire demonstrate the reach of the contributions of the four individuals even more strongly.

We are about ideas that change the way that people think. We are about discovery. We are about investigation. We are about the urge to know, the demands of critical thinking and the relationships among ideas. But you will find that your education here will serve you well in the marketplace too. This does not mean that it is our goal to provide you with an education that will lead to maximal income. It is not, nor do I believe that such a result is what you expect or consider most worthwhile.

It would be foolish to ignore the economic consequences of your education, including the substantial cost of providing it. However, it is clear that any thoughtful consideration regarding the costs and benefits of education must take into account the fact that education has benefits for an individual and for society that go beyond the generation of income. You will leave here better thinkers, better informed, and better able to understand and participate in the world. For our present purposes it is enough to say that the skills we emphasize and the thinking we encourage at Chicago are highly valued in the larger society.

I will now speak briefly about the Core and general education at Chicago. The Core at Chicago is our attempt to provide you with a base of knowledge that is broad enough that you and we will be able to “speak to one another.” Although the texts that make it into the Core are all very important, they are not the result of a “contest” in which the faculty gathers in order to rank the knowledge and texts that are deemed “most important.” Nor is the Core a catalog of received wisdom whose mastery defines a liberal education. The construction and teaching of the Core give the faculty the opportunity to explore with you relationships among texts and disciplines and to devise courses that provide an integrated educational experience. I will wager that many of you, perhaps even most of you, heard that Chicago is about the Core before you heard that it is about research and discovery. You will find that the Faculty would vote for the primacy of research and discovery.

And there are important relationships between discovery and the Core. The subjects that are included in the Core all reach a level of “importance” that we aspire to match in our own investigations. But in addition, by relating the works of great thinkers across time and among disciplines the Core encourages us to consider big questions and to distill the learning that has come to us from a variety of directions.

Sontag, for example, recalls being asked, “How would you compare Aristotle’s and Aquinas’s ideas of virtue?” It is reasonable to conjecture that our successes in producing graduates who are inclined to think big in later life is somewhat grounded in our insistence that they consider relationships and think big in the classroom. I hold the view that the most important role of the Core is that it prepares you in this way for discovery. It is an experience designed to aid you to understand and construct what lies ahead, and its success should be judged by that criterion. It turns out that we know a good deal about the nature of discovery, and that what we know supports my view regarding the importance of considering relationships among ideas. A very large proportion of the best work at the boundaries of what is known and at the boundaries of creative expression depends on our ability to see connections and to integrate existing knowledge and technique.

Our own considerable successes at Chicago provide many such examples: Fermi and the nuclear pile brought together physics, chemistry, and engineering at the highest levels. Law and Economics and Urban Sociology are two examples of fields of study that were largely initiated here, with giants such as Ronald Coase, Aaron Director, James Coleman, and Gary Becker playing leading roles, and crossing disciplinary boundaries. And this productive tradition continues. Witness Jim Heckman’s path-breaking analysis of the development of human capital, and its relationships with what is known about fetal programming. Witness our

significant efforts in behavioral economics and its relationships to psychology.

A further example of what I will now call the unity of knowledge has us escape from Chicago and allows me to introduce you to the Berkeley mathematician Edward Frenkel, *and* his book, *Love and Math: The Heart of Hidden Reality*. This recently published book is number four on my list. It makes an extreme case for the unity of knowledge and concludes with the dream of math as a force that one day can leave us “marveling at the dazzling beauty and harmony we discover, share, and cherish together”: as in true love!

Back to earth.

The book provides a glimpse at how advances in mathematics have influenced the way we model the physical world. The mathematical framing concerns Fermat’s Last Theorem (which is almost ancient – 1637) and the Langlands Program, which is modern “hot stuff” in math world. The physics concerns quantum field theory, which goes back to Heisenberg almost 100 years ago, and continues to recent developments in string theory. The relationships that Frenkel describes among seemingly disparate areas of mathematics and between math and physics are striking. An important aspect of the relationship between mathematics and physics has been noted by the physicist Eugene Wigner, who points out that “the mathematical formulation of the physicist’s often crude experience leads in an uncanny number of cases to an amazingly accurate description of a large class of phenomena.”

But a cautionary note is in order. The creation of important new knowledge requires more than a random mixing of the disciplines. The magical usefulness of mathematics for physics has not been replicated so clearly in the case of mathematics for biology. String theory may be beautiful mathematics as opposed to physics. We do not yet know. And personally I find Frenkel’s conclusions regarding the unity of math and love to be a bit of a stretch, but I leave this for you to evaluate. The creation of fundamental new knowledge is a deep and mysterious undertaking. I believe that interdisciplinary connections are important, but the genius is in the choice of problem and the particular connections.

We have covered a number of topics: research and discovery as our defining value; a brag list of graduates of the College; some reflections on humanistic study; how to think rather than what to think; the value of a Chicago education; and The Core. Now to the most challenging part of my thesis. I will argue that there is a connection between the considerable achievements of graduates of the College, the learning environment at Chicago, and our defining values. I will argue that the deepest discoveries – not routine results, but the stuff that changes the way we view the world and understand the nature of our very being – are produced by individuals with certain habits of mind. I will argue further that these habits of mind are actively cultivated at Chicago. To illuminate this connection, one must explore the anatomy of bold and extraordinary creations. And for this I turn to the work of my colleague, a Nobel laureate, Robert Lucas.

The study of economics is commonly divided into microeconomics and macroeconomics. Microeconomics is concerned with the prices of individual commodities, as well as the consumption and production of these commodities. Macroeconomics is concerned with aggregate quantities such as the price level, the wage level, unemployment, the quantity of money, and national income. Since the time of Adam Smith’s *Wealth of Nations*, the biggest questions in both microeconomics and macroeconomics concern the following: When does self-interested behavior, selfish behavior, promote the social good and when does the social good require governmental action?

There is broad agreement concerning the identities of the two greatest macroeconomists of the past century. They are John Maynard Keynes and our colleague Robert Lucas. In a recent issue of the *New Yorker*, Nicholas Lemann makes the case for Keynes: “He came up with what might be the most successful liberal idea of the past century: that careful governments, through spending, taxes, and manipulating interest rates, could prevent the periodic economic disasters that have characterized modern capitalism.” Lemann continues with the case for Lucas: (slightly paraphrased) “...in a path breaking paper in 1976 “Econometric Policy Evaluation: A Critique” (Lucas) convincingly argued that government economic policy could not control the rates of inflation and unemployment for any length of time. Prices and wages would always set their own levels. They would be determined by market forces.”

Keynes initiated the modern study of macroeconomics; however, since the Lucas critique, macroeconomic analysis has operated according to different rules. It has become more rigorous and better integrated with microeconomics. In particular, there is a greater emphasis on “rational choice” and one questions the ability of the government to systematically outsmart the public. To put this plainly, when private citizens are assumed to have as much intellect as policy makers, it becomes difficult to justify the Keynesian conclusions regarding a useful role for government in the regulation of macroeconomic variables. This is NOT to suggest that Lucas’s perspective “solves” the basic issues of macroeconomics. Among wise and able economists and government and business leaders there remains substantial disagreement regarding the appropriate role for government policy; however, Lucas completely changed the terms of the debate.

Now some words about the path that took him there. Lucas intended to study engineering in college and was well prepared in mathematics, but when Chicago offered a scholarship and MIT did not he needed to find another course of study. He tells us, “The real excitement (in the Chicago College) was in the liberal arts core with names like History of Western Civilization, and Organization, Methods, and Principles of Knowledge.

... All of them began with readings from Plato and Aristotle, and I wanted to learn all I could about the Greeks.” This led Lucas to the graduate program in classical history at Berkeley, but happenstance and a deficient preparation in classical languages took him back to Chicago and Economics, where he needed to begin again with undergraduate courses in economics. You can read the rest of his story on the Nobel Prize website.

Lucas brought to economics the perspective of someone first trained in history. The ups and downs of the macro economy, the extraordinary swings that have occurred in the economic growth of nations – these would be among the first important observations of a historian. But to explain them in a rigorous manner is a substantial technical challenge that economists have not solved. So we have perhaps paid too little attention to the question. Keynes too had the advantage of an historical inclination. Read his *Economic Consequences of the Peace*. It is Number 5 on my list. Lucas was also good at math and he developed some strong elementary math skills before coming to college. When he returned to Chicago from Berkeley and turned his mind to mathematics and analytics, he tells us that he quickly became “as good a technician as anyone on the Chicago faculty.” The Core encouraged Lucas to ask big questions and explore fundamental relationships, even across disciplinary boundaries. Is that all there is to it: thinking, relationships, the Core, the unity of knowledge? Of course not. But it is not a bad start.

A key to where I am headed is found a bit further down the page on the Nobel website that I mentioned. There, Lucas tells us that one of the great lessons he learned upon returning to Chicago “was from Milton Friedman, who exemplified the idea of following economic logic where ever it leads.” Preconceptions, experiences, and prejudices must not get in the way.

Economists are frequently drawn to their discipline because they believe they can create knowledge that will improve the human condition. This is good and noble. But, consider the courage it takes to challenge the basic thinking of a sizable and influential chunk of one's own profession. Even more, consider the difficulty of coming to the conclusion that all theories of how to be helpful will face a major conceptual difficulty. Or, in more specific terms, all theories of how to design macro economic policy to even out swings in income and employment will face a major difficulty. We wish to be helpful and there is a piece of us that resists such a conclusion, especially when it involves setting aside ideas that we have worked hard to master. Being able to follow 'reason' wherever it leads is a test of character. It is also a 'habit of mind' that is encouraged and more easily developed in a community in which discovery and research are a defining value.

I do not know how Lucas came to consider how the Keynesian conclusions might be affected by insisting that policymakers not be able to outsmart the public. Perhaps this was a flash of genius, perhaps it was the influence of some game theory ideas that were pushing their way into economics. It does not matter much. At a fundamental level his work required that he be animated by curiosity and have the courage to question the foundation of a body of work that was widely held. It required that he follow the logic of his assumptions, even when the conclusion contains a bitter pill. It was a test of character.

At the frontiers of learning and discovery there is no coach to lead you to the right questions or to put you on the right track. I have described how we try to get you started. But our goal is to help you to become your own guide...to fan the flames of the "urge to know." The discipline to know what you know, and know what you do not know is most essential. Again, it is a test of character. It is supported by 'habits of mind.'

How difficult is it to develop these habits? I draw your attention to the fact that when Lucas first submitted his 'Critique', for which he was subsequently awarded the Nobel Prize, it was rejected for publication. Lucas had to be resilient. Resilience is a test of character.

When the great Chicago astrophysicist Subrahmanyan Chandrasekhar travelled as a junior scientist from his home in India to England, he found himself surrounded by the likes of Dirac, Rutherford, Hardy, and Eddington, who was considered the leading astrophysicist of his time. Chandrasekhar's knowledge of the then new quantum mechanics and relativistic effects led him to conjecture and understand the existence of what we now know as black holes. The possibility of such structures in the universe was strongly dismissed by Eddington. Chandrasekhar was publicly ridiculed. To push on was a test of character, but I believe it was also a 'habit of mind' for him. It was what his curiosity forced him to do. It was also his responsibility to the truth.

The point of all of this is to say that our unusual success in undergraduate education is related to the fact that we have historically made the importance of research and discovery a defining value. From a faculty perspective it is very fulfilling to be at a place that values research and discovery so highly. From a student perspective it is valuable to be at a university that cultivates 'habits of mind' that are associated with creative thought. When discovery is your business the burdens are substantial. When you are in an environment in which it is a habit to "insist on knowing," the burdens are substantial. You may be excellent, but you must not be excellent sheep. Over the years, neither students nor faculty have come to Chicago to graze. We must accept the burden of maintaining this tradition. *Excellent Sheep*, by William Deresiewicz is Number 6 on my reading list.

And so I conclude. Despite the beauty and even serenity of our campus we do not exist to make you comfortable.

Despite the fact that you will make friendships with some exceptional people that will last a lifetime, we do not exist to help you to build your Contact List or enhance the value of your social network.

Despite the fact that we structure the educational experience somewhat more than most other universities, and despite the fact that you are in an environment where many people burn the midnight oil, you will have considerable freedom. You will decide for yourself when to rise in the morning, where to concentrate your efforts, and when to play. It is your responsibility to make wise choices—at least most of the time. We do not pretend to do this for you.

Learning about your capacities, your talents, and your passions is hard. We understand the challenge – I probably better than most. I entered College at age 16 and made a hash of it. My grades were mediocre at best -- several C's and on occasion worse. I slept during the day and played poker at night. I was given opportunities that I did not understand and chances that I had not earned. Like Fromberg Schaeffer, I was not “led by the ear:” I was allowed to discover my own path and to do it in my own way. I will leave out the details of how it happened; let's simply say that I found my passion, my curiosities, and that there was a good deal of hard work and good fortune. Ten years later I had solved a big problem and this led to privilege and possibilities: a full Professorship in my mid-twenties, a career surrounded by the best and the brightest, and eventually the power to create for others the life that the opportunity to learn and discover had made possible for me.

I counsel you to resist the pressures to set too firm a course in advance of learning ‘who you really are.’ Now is the time to work hard, experience, experiment, and even dream.

I have emphasized the importance of character building, but I do not wish to suggest that we are the Marines. The nature of our work is to challenge you and to encourage you to challenge yourself. Delight in your hard-won discoveries, and glory when these allow you to view what nobody else has seen before. Be proud that you are in a place of remarkable people and remarkable accomplishments. The fact that you chose Chicago tells us a great deal about your character.

You belong here. May your journey be not too comfortable. May each of us be curious, find our way, and experience the joy of discovery. Our history and defining values will bring wind to your sails. May knowledge grow and help to create a better world.