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AIMS OF EDUCATION ADDRESS 2006

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OBSERVATIONS CONCERNING THE AIMS OF EDUCATION

Welcome to the University of Chicago. You have probably heard that phrase at least 137 times this week. You have heard it so often that you probably hope the next person to address you will say something else, anything else. Even "have a nice day" might be a welcome change. "Welcome to Chicago" is often followed by well-meaning advice about how to succeed at the University of Chicago. That you won't get from me. Instead, after this "welcome," you will get some advice about advice.

Last year in Chicago, there was a theater festival honoring Chicago-born playwright David Mamet. One evening he spoke about his early years in the theater. In response to an audience question about the importance of a mentor, he said that when you start out doing anything, someone just a little older or more experienced will pull you aside and tell you what you have to do to succeed. Then, Mamet said that the most important thing is to absolutely, positively ignore everything that person tells you.

That, in itself, is beautiful Zen-like advice. "Ignore advice" is, well, advice. It is advice that is impossible to follow, and at the same time impossible not to follow. I guess that is one of the reasons many regard Mamet as a genius.

The Aims of Education Address has been inflicted upon incoming classes at the University of Chicago since the early 1960s.

"The Aims of Education" is a wonderfully vague title. Is it a question, as in "What Are the Aims of Education?" Or is it a simple declarative sentence saying, "Pay attention, because I am about to tell you the aims of education."

The word "aim" in the title suggests that there is a target for your education, something to shoot at, to aim for. I will take the literal meaning of the word aim. "Aims," in the plural, suggests multiple targets. Most would agree that there are many targets. Of the many possible, this evening I will suggest one target for this next step in your education, one that may not have occurred to you. I will also talk about one target some feel should be an aim of education, and then I will argue why you should not aim at it.

In preparing these remarks, I looked through a fair number of the last forty years of Aims of Education Addresses. (That's a very useful phrase, "looked through." It doesn't mean "studied." It doesn't even mean "read." When students tell me they "looked through" a reading assignment, it usually means they carried it around in their backpack for a week or so in the expectation that the words and ideas in the book would somehow by osmosis be absorbed through the backpack, jacket, and shirt, eventually finding their way to the brain. When I say I "looked through" previous addresses, I mean that I actually took them out of my backpack and read a few.)

Despite forty years of discourse, some of the sharpest minds in the world (i.e., my University of Chicago faculty colleagues) have failed to come up with a definitive answer to "the aims of education." In fact, they did not even agree on the meaning of the title. Of course the aims of education have been discussed beyond the boundaries of Hyde Park and even further back in time than forty years ago. The world's greatest thinkers and philosophers, from Aristotle to Alfred North Whitehead to Dr. Phil, have discoursed on the aims of education.

Aims of Education Addresses have been presented by an anthropologist, a philosopher, a member of the Committee on Social Thought, a member of the Department of Comparative Human Development, and a member of the Committee on History of Culture . . . and that was just one person!

This year's version of this peculiar academic tradition will be presented for the first time by a cosmologist. It is rather uncommon for someone in the physical sciences to present this address. I am only the second from the Department of Astronomy and Astrophysics to present it. I didn't recognize the name of any active faculty on the list of previous presenters from the Departments of Physics or Chemistry or other units in the Division of Physical Sciences.

Why have physical scientists been under- represented? It is out of character for a scientist to think about topics like "the purpose of life," "the meaning of love," or "the aims of education." We usually address questions that can be framed in exact mathematical terms. We present answers (on those rare occasions when we can find them) in the form of graphs, tables, and equations. I am also used to working on problems that people actually expect to be able to answer one day. At the end of a science paper, you can usually tell if that problem has been solved and that it is time to move on to another. I don't believe anyone expects a definitive answer to the aims of education.

Usually scientists do not write papers without conclusions. We either say we have solved the problem, or we say we haven't. But this evening, I will not solve anything or present any final conclusions about the aims of education. I will just offer two observations remotely related to the aims of education that I thought about last night while listening to the dishwasher.

It may be appropriate for a cosmologist to address the aims of education; after all, it is a big question. And cosmologists are used to dealing with big questions. Why have cosmologists been strangely silent on the aims of education? We write books and papers about the origin and destiny of the universe, about the nature of space and time, even about a theory of everything. Cosmologists are bold, some might say brazen and reckless. We don't shy away from big questions. But cosmologists have not addressed the thorny issue of the aims of education—until tonight.

It is a good idea to know something about the background of the person giving an address. You already know I am a cosmologist. Most of you even know what a cosmologist does. At least I hope you know the difference between a cosmologist and a cosmetologist. A cosmetologist deals with the universe of makeup, while a cosmologist deals with the makeup of the universe.

There are also different kinds of cosmologists. Basically, there are three types of cosmologists: those who can count and those who can't count. Cosmologists can also be separated into observers and theorists. Theoretical cosmologists are expert in starting with very little input and getting a lot of output. Input a few laws of physics, and output the universe. I am proud to be a theoretical cosmologist, so I am going to input one poem and output an observation concerning the aims of education.

The starting point for my first observation on the aims of education is a poem written by Theodor Geisel. It's not very long, so I can read the whole thing to you.

"My Uncle Terwilliger on the Art of Eating Popovers"

My uncle ordered popovers
from the restaurant's bill of fare.
And, when they were served,
he regarded them
with a penetrating stare . . .
Then he spoke great Words of
  Wisdom
as he sat there on that chair:
"To eat these things,"
said my uncle,
"you must exercise great care.
You may swallow down what's
  solid . . .
BUT . . .

you must spit out the air!"

And . . .
as you partake of the world's bill
of fare,
that's darned good advice to
follow.
Do a lot of spitting out the hot air.
And be careful what you swallow.

This poem was composed for the ninety-ninth commencement of Lake Forest College and presented on June 4, 1977, by Theodor Geisel, known to most as Dr. Seuss.

Over the next four years you will be served a lot of intellectual popovers. You will be offered a wide variety of treats from the table of intellectual ideas. Some of them will be so outrageous and revolutionary they would make ministers blush, local school board members faint, and parents wonder why they didn't just send their children to the local community college. So friends, let me propose that an important aim of your education is to learn how to spit out hot air and only swallow what's solid.

If I were really smart, I would just stop here and sit down, and we could all go back to the dorms and discuss the deeper meaning of Dr. Seuss's poem. To tell the truth, what I would really like to do is spend the rest of the hour telling you about my latest theory for the dark energy that seems to be driving the basic fabric of cosmic space everywhere in the universe in an ever-increasing expansion.

But one of the rules of the International Union of Professors and Other Useless Professions is to never finish a lecture until you have made every generalization, explored every nuance, and exhausted every subtlety. And if you can't exhaust each and every subtlety, at least you can exhaust each and every student.

So let me push things a little farther and propose that it is not good enough just to spit out the hot air of whatever intellectual idea you are being fed at the moment, you have to learn to expel the hot air of ideas and beliefs ingested so long ago that you don't even remember swallowing them. But they are there in the intellectual pit of your stomach, in the core of your beliefs. You have already swallowed a lot of hot air.

So my first observation concerning the aims of education is that one of the aims is to develop the capacity to question things that you already "know," uncover your unknown knowns, and expel the hot air.

What do I mean by unknown knowns?

Let me start with the famous words of "The Donald." Not Trump, but Rumsfeld. In a Department of Defense news briefing on February 12, 2002, Secretary Rumsfeld said:

As we know, there are known knowns. There are things we know we know. We also know there are known unknowns. That is to say, we know there are some things we do not know. But there are also unknown unknowns, the ones we don't know we don't know.

Got that? Now for some reason, a lot of comedians have joked about that statement. At first I thought Rumsfeld was just making a little joke, but I could find no evidence that he possesses a sense of humor. Perhaps the secretary of defense should be the one person in the country without a sense of humor. Then I thought about Rumsfeld's many trips to Afghanistan and figured he was just stimulating the local economy of that poor country by smuggling and using its traditional agricultural cash crop.

But the more I thought about it, the more I realized Rumsfeld was right on. Gradually I came to believe that his statement was just short of brilliant. The only reason it is "short" of brilliant is that Secretary Rumsfeld didn't go far enough. He should have added,

Finally, there are the unknown knowns, that is to say, there are things we "know" that turn out to be not so.

There is a saying that is variously attributed to Mark Twain, H. L. Mencken, Will Rogers, Winston Churchill, or Harry Truman. But as far as I can tell, it was first published by the somewhat obscure nineteenth- century American writer Charles Farrar Browne, who wrote under the pen name of Artemus Ward. He wrote:

It ain't so much the things we don't know that get us into trouble. It's the things we know for sure that just ain't so.

The fact that you have been admitted to an elite university is evidence that you know a lot. Although you know a lot, hidden among the things you think you know are things that ain't so. It's the same for us all. I can't say what you know that ain't so, anymore than I can say what I know that ain't so. I only know we all have unknown knowns. I'm sorry, we all do.

For example, it was once known that Earth is flat, it was once known that Earth is the center of our solar system, it was once known that the solar system is the center of our galaxy, and it was once known that our galaxy is the center of the universe. You may not believe this, but it wasn't so long ago that everyone knew that Pluto was a planet. Now we all know those things

just ain't so. Now, no one believes Earth is flat and is at rest in the center of the universe, at least no one outside of the Kansas State Board of Education.

Let me again suggest that an aim of education is to develop the ability to question all that you know, all that you were ever taught. If the aim of education is to only teach children to read and not to question what they read, we will end up with every child left behind.

The greatest scientific discoveries have involved overturning unknown knowns. There is no better illustration of spitting out the hot air of unknown knowns than the work of Albert Einstein. Einstein looked at the equations he scribbled while working at his desk in the Swiss Patent Office 101 years ago and expelled the hot air that space and time were absolute and unchanging. Ten years later, as a professor at the University of Berlin, his equations led him to overturn the unknown known that space was flat, rather than curved. Since the time of Euclid, everyone had swallowed the fact that geometry is flat.

Einstein's greatest discoveries came about because he questioned what was known; he reasoned things out for himself, rather than accepting what was known.

Even a genius like Einstein had unknown knowns. In 1917, two years after perfecting his theory of gravity, his equations led him to the almost inescapable conclusion that space should be expanding. Einstein should have predicted the expansion of the universe twelve years before Edwin Hubble, an alumnus of the University of Chicago, looked through a telescope and discovered the expansion. But Einstein didn't. He didn't believe his own equations because he "knew" that space didn't expand. It was only one of Einstein's unknown knowns.

Einstein had other unknown knowns. He just "knew" that quantum mechanics could not be correct. There are always things you "know that ain't so." The greatest scientists throughout history all had them: Copernicus, Kepler, Galileo, and Newton. We have them too.

One of the dangers of unknown knowns is that they lead you to see what you expect to see, not what is really there.

Indeed, some of the greatest scientists have erroneously confirmed the existence of non-existent phenomena. Among the greats who erred in this way were Galen and Leonardo.

During the second century of the Christian era, about the time the Greek astronomer Ptolemy was watching the skies in Alexandria, Clarissimus Galen, a Greek physician living in Rome, was studying human anatomy. A patient and accurate observer of nature, his anatomical investigations were unrivaled in antiquity and hardly surpassed as late as the seventeenth century. For 1,500 years, just as Ptolemy was considered the authority on all things astronomical, Galen was regarded as the authority on matters anatomical. Just as in the case of

Ptolemy, Galen's reputation was well deserved. He was responsible for a vast number of discoveries about the human body: For example, he demonstrated that the arteries contain blood and not air, as popularly believed at the time; he made noteworthy contributions to neurology; and, in an age when most physicians jealously guarded their knowledge lest another physician discover it and steal their patients, Galen published hundreds of papers and books on medicine, along with many on philosophy, comedy, and logic.

In the curious Roman world, where the slaughter of gladiators was considered wholesome family entertainment, the public recoiled with horror at the thought of medical examination of the losers, so most of Galen's information was the result of dissection of apes and other animals. While the bulk of his anatomical observations were true to nature, there were some curious exceptions. Galen believed, as did many physicians of his time, that women had two uterine cavities, one on the right for the male fetus and one on the left for the female fetus. But what concerns us here was his "model" of the human heart.

In De Usu Partium, Galen described the anatomy of the human heart and the circulatory system. For well over a thousand years, his was considered the final word on the heart and circulation of the blood. It was not supplanted until William Harvey's great work of 1628. But in Galen's description of the heart, he erroneously reported that the septum was permeated by a multitude of barely perceptible foramina, through which some of the blood exuded from the left ventricle to the right ventricle.

The study of human anatomy in the Western world did not advance much further for a thousand years after Galen, in part because in the equally curious Christian world dissection for the purpose of the acquisition of scientific knowledge was forbidden on the grounds that it was impious to mutilate an image of God (unless the particular image of God was judged to be a witch or a heretic).

Interest in human anatomy was rekindled in the Renaissance. The action and purpose of the human heart could not escape the relentless curiosity of Leonardo da Vinci, who was one of the first of the modern dissectors until Giovanni di Medici, Pope Leo X, banned him from the Roman hospital, calling him "a heretic and cynical dissector of cadavers." Leonardo was well on his way to discovering the principle of the circulatory system, but as in the case of so many of his other investigations, as well as art, he seemed pathologically unable to bring it to a final conclusion. (On another occasion Leo X said of Leonardo, "This man will never finish anything, for he starts by thinking about the end before the work is begun.") Nevertheless, his study of the human heart was without parallel among his contemporaries. Leonardo's red-chalk drawings of the heart show an incredible attention to detail, for the most part rivaling anything to be found in Gray's Anatomy, either the book or the television show. In its own way, Leonardo's drawings of the human heart possess the same sublime beauty as the smile of the Mona Lisa.

It is well know that Leonardo was fiercely independent of authority in scientific investigations. He expressed himself in his famous notebooks. He wrote:

I do not understand how to quote from learned authority, but it is a much greater matter to rely on experience. They scorn me who am a discoverer; yet how much more do they deserve censure that have never found out anything, but only recite and blazon forth other people's works. Those who study only old authors and not the works of nature are stepsons, not sons of nature, who is mother of all good authors.

Yet, despite his declaration that he did not rely on the old authors, when Leonardo drew the human heart he included minute partitions in the septum that were placed there by Galen, not by nature. But Leonardo did not include the partitions because he "trusted" Galen as the supreme authority, but because he thought he actually saw them.

No less an acute observer of nature than Leonardo da Vinci at times saw what he expected to see, not what was really there.

When Leonardo held an open human heart in his hand, he expected to find holes that were just barely large enough to see. And he saw what he expected.

One of the aims of your four years of education here should be to discover your unknown knowns. Challenge yourself! Challenge every sacred idea you have. Nothing is too sacred to challenge. Is there a god? Is there more than one god? Is there an infinite number of gods? (I'm not sure of the answer to that, but the answer to most problems I work on is zero, one, or infinity.) Examine your most deeply held beliefs. Have the courage to face the possibility that something you know just ain't so.

There are many advantages to youth. One of them is that only when you are young do you have the time or inclination to reach down really deep inside and face the unknown knowns. It could be that when we get really old—say, twenty-five years old or so—we are focused on careers, family, graduate school, and other things. Perhaps we become so calcified that the hot air can no longer escape. Maybe it becomes more painful with age to expel the hot air. It seems the longer the hot air stays inside, the harder it is to get it out.

The statement that an aim of education is to discover your unknown knowns is different than the statement that an aim of education is to learn how to think. You already know how to think. You would not have been admitted to an elite university if you didn't already know how to think. I'm not sure education teaches you to think. Anyone who believes that education teaches you to think has never been to a faculty meeting!

The suggestion of a target is the first (and longest) of two points in this address, "Observations concerning the Aims of Education."

Now let me suggest something that should not be a target at which to aim. About the only thing speakers who delivered the last forty Aims of Education Addresses agreed on is this: You are not here to learn job skills. Universities, and certainly not the University of Chicago, are not centers for job training.

Perhaps a better use of your energy is to learn things that will not be part of your future occupation. I say that for two reasons.

The first is that much of what you learn over the next four years probably won't be very useful for your occupation. Not only that, but many of you will end up in a different profession than you now foresee.

Most of you may believe you already know what you will do, but let me convince you that may not be so. I've learned that it is easier to convince people by quoting statistics. So let me convince you with some statistics I fabricated last night.

Twenty percent of mathematics majors will end up in software development (that is not too surprising), 14 percent will end up as college professors (presumably in mathematics), but 10 percent will end up in banking or finance, and the remaining 66 percent will be spread over a variety of professions. So, only 14 percent of mathematics majors will end up filling in "mathematician" on their annual IRS 1040 form. Even including software developers as mathematicians, 66 percent of you majoring in mathematics will do something else.

The same is true of majors in the social sciences. Twenty-four percent of history majors will become lawyers. Twenty percent of those in psychology will end up in the business world, and so on. The same trend applies in the humanities as well: of philosophers, 30 percent will become lawyers and 18 percent will end up in software development.

Now, I didn't really make up those statistics, but they must be true because I got them from the Internet. No, actually they were in the 2002 Aims of Education Address delivered by Andrew Abbott. They do agree with my experiences meeting alumni. Of my own students from physics and astronomy, some are in the biological sciences, some are on Wall Street, and some are in various other professions. Only about half are doing physics or astronomy research.

I don't know how relevant the study of the Philosophy of German Idealism is to passing the bar exam, or how useful Fermat's last theorem will be on Wall Street.

Even if you are in the minority who will eventually be a member of a profession directly related to your major, not much of what you learn over the next four years will be used in your daily work. My own experience is that what I learned in physics courses as an undergraduate made it easier to learn the material in graduate classes, which made it easier eventually to learn what I had to learn to do physics research.

The second reason not to aim your education toward your profession is to prevent a life-threatening disease. When I was a child, my grandmother used to worry about something she called "hardening of the arteries." I suspect that is no longer a proper medical diagnosis. Otherwise I would have seen television advertisements featuring smiling people riding bicycles or doing some other activity illustrating the wonderful life that can be yours only if you take some expensive medication to soften your arteries.

The academic equivalent to hardening of the arteries is something that has been referred to as "hardening of the categories."

It is premature for you to allow your categories to harden. Just because you are a history major doesn't mean that you should not study mathematics or physics or cosmology. Some of you are not looking forward to science courses, but you should!

History majors should know of the accomplishments of Einstein, Newton, Darwin, Copernicus, and Galileo. Theirs were some of the greatest intellectual achievements in history. The next four years may be your last opportunity to learn in a classroom setting of the scientific ideas that changed the world and shaped the modern mind. We live in a scientific age. It is surprising to note that in the index of the 1946 abridged (if over seven hundred pages can be consider abridged) version of Arnold Toynbee's 1934–61 classic A Study of History (the abridged volume compiled by D. C. Somervell), the names Copernicus, Kepler, Galileo, and Newton do not appear. In Toynbee's complete ten volumes, there are only three brief references to Copernicus, two to Galileo, and three to Newton—all as asides.

In the past century, even in the last year, we have made remarkable advances in our understanding of the composition and origin of the universe, the origin of space and time, the structure of matter, and the first microseconds of the universe.

These ideas, these accomplishments, are today truly understood by at most a few hundred scientists, but everyone can appreciate them.

Some of you may have read a book titled Stephen Hawking's Universe. I have great respect and admiration for Hawking; he is a friend and colleague. Perhaps no one knows more about the universe than Stephen. But it's not his universe. It's your universe too!

You should know that the universe is expanding, and why. It won't help you get into law school, medical school, or business school, but it will help prevent hardening of the categories.

Science majors are also at risk for hardening of the categories. Given the choice between taking yet another physics course or electing a course in eighteenth-century French literature, don't turn your back on the humanities!

My own college education included more than the usual amount of humanities for someone majoring in physics. As a result, when I started graduate school I started slightly behind others who had completed more technical courses. But in a month or so, I caught up. If I had it to do over again, I would have taken a few more history courses and a few less mathematics and physics courses. The technical stuff you can pick up on the streets, or at least in graduate school.

Here at the University of Chicago, you are lucky in this regard. With a traditional strength in a common core, faculty members in the sciences, humanities, and arts link arms together for a common purpose: to fight the great Satans of modern society, the economists. Actually I have great respect for my colleagues in the Egonomics Department.

Let me conclude by observing that I have suggested only a good target and a bad target for your aims of education. The good target is to develop the ability to swallow only the truly solid and spit out the hot air of ideas, and to expel the hot air of your unknown knowns. The bad target is to view education as development of some set of job skills.

But I have not yet given you any advice on how to hit any target in your own aims of education.

Maybe the best way to be on target in your own aims of education is to follow the procedure of the archer who represented the Greek city of Abdera in the Olympics of ancient Greece. The Olympic team from Abdera was always getting kicked around by Athens and Sparta. They never won—they were perennial losers; they were a joke; they were the Chicago Cubs of ancient Greece.

The king of Abdera was not a great king. Although his name was Alexander, he was not Alexander the Great. In fact, he is known to historians as Alexander the Adequate. This Alexander finally found a way for Abdera to win an Olympic gold medal when one day he noticed that on the barn of a local farmer was a row of twenty-seven arrows in the dead center of the bull's-eye. He convinced the farmer to represent Abdera in the Olympic archery competition. But it didn't work; the farmer returned to Abdera having finished dead last in the archery competition. Alexander the Adequate couldn't understand how the farmer lost, so he asked him to demonstrate his archery skills. The farmer carefully took aim, let the arrow fly,

and then took out his red paint and methodically painted a bull'seye around where the arrow hit.

So I've suggested one target for your aims of education. You will find your own. You may start your education aiming to be a poet, but end up as a publisher. You are each talented, and you are a student at a great institution. Let your arrows fly with the certainty that they will hit a target, no matter what your aims of education. You can always paint the bull's-eye later.