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PROFESSOR: Today I want to make some remarks about William Barton Rogers. You were supposed to read an essay that I wrote about him, so I'm not going to go into great detail. I don't want to repeat what I've already written in the essay, but I thought I would hit had some high points and then end up talking a bit about this piece that Charles Eliot wrote called "The New Education," because I readily admit that that is not the easiest thing to read and surely not scintillating prose-- you would not want to keep it up with you at night and think you're going to read it one AM.

That wouldn't work. But it's an important essay. So we'll talk a bit about that after I make my few remarks here. First thing I want to say is that it's hard to believe that MIT has no full-scale history-- history book, that is, a book that's been written about the entire history of MIT. One does not exist.

As close as we get to it is the book you're reading now. And basically that consists primarily of snapshots of critical moments in the institute's history. I think it's a very good book, but it's not a complete history of the Institute. And hopefully, someday, someone will decide one is needed and actually write it. It will take it a lot of work because the more I read and study about this place, the more I realize that it has a very deep and very diverse history. And it will not be an easy book to write, in my opinion-- or at least to make it a good book, that it really should be.

But all the great universities in the United States have these histories and MIT is one of the few that doesn't. And I was sort of surprised at that. I must admit, I didn't know a thing about the history of MIT until about two or three years ago, when I was asked to write this essay, and then, all of the sudden, I, of course, started to read as much as I could about it in preparing for the essay that I wrote.

But I was really surprised that there's no one big book you can go to and kind of get the story there. My assignment by the editor of the book *Moments of Decision*, his name is David Kaiser, and he teaches in the STS program, history of physics. He's also a physicist. He has a Ph.D in physics. And he persuaded me to write this essay, which I did because he was my colleague, not because I wanted to, I must admit. But I'm glad I did in retrospect because I learned a lot about this place and especially about its early years.

And so what that in mind, I want to talk about, well, what did I learn from this extensive reading that I did, and what did I learn especially about William Barton Rogers the person and the significance of his life? I think it's fair to say from the outset that he is a very significant educator. In the larger history of education, he has to be one of the more important people of the 19th century.

He came of age in the middle of America's Industrial Revolution. He was born in 1804, so he was in his 20s during the 1820s, right at the very moment when the United States was really beginning to experience factory systems, the mechanization of production, the advent of railroads-- it was the moment. It was the right moment to be in the country, to see these changes taking place. And he saw them, and he was very, very interested in them, though he always considered himself to be a scientist.

He was initially educated by his father, primarily, at William and Mary. His father was an academician. And he initially called himself a natural philosopher, which would be a 19th century word for a physicist, basically. Natural philosophy-- interesting name.

But technology in those days, interestingly, was also referred to as "the useful arts." The word technology, in the 1820s, I don't even know if it had appeared in the United States at that point. But in any case, it was a very new word to the lexicon and it was rarely used until we had the founding of this place, the Massachusetts Institute of Technology. It's very interesting that he chose that word. If I could go back and interview Rogers, that would be one of the questions I'd want to ask him, is why did you choose the word technology, not Massachusetts Institute of Useful

Arts, or some more contemporary expression that was used, frankly, more often than the word technology was, by 1860.

In any cases here he is. He's a young man during the 1820s. His first job out of college was to teach in a small private school in Baltimore Maryland. And it's in Baltimore that he comes in contact with some of the really famous railroad engineers of the early 19th century. All of these guys were West Point-trained people. They were army engineers who had been basically seconded to the Baltimore and Ohio Railroad, a private corporation, to initiate surveys and construction of this privately owned railroad.

Talk about government in. It's a great example, in which, here, the federal government is actually sending its own personnel to a private corporation to get the job started. And so he meets people like William Gibbs McNeill and George Washington Whistler, who, actually, are brothers in law.

Whistler is the more interesting of-- well, more historically interesting of the two. They're both important engineers because his son became a very famous artist, James McNeill Abbott Whistler, is George Washington's son. And the famous portrait, Whistler's mother, that sits in the Louvre in Paris is of George Washington's wife, who was a McNeill as a young lady.

So here you have these engineers in Baltimore interacting with this young teacher because he got interested in railroads and wanted to give a lecture about the building of this new steam powered railroad out of Baltimore westward toward the Ohio River. And he started borrowing models from these engineers to illustrate his lectures with. They were building very interesting and fairly, not large scale models-- but I've seen some of them, they currently exist in Russia, they're found in a museum in St. Petersburg-- of the type of bridges that were being built on the B&O railroad, and the types of locomotives and rolling stock. A locomotive would be maybe that long, a 440, that wide, it's this high, fairly sizable model.

But he was borrowing these models to give lectures with and, in the process, began to get interested in railroads, and especially because his brothers, two of his

brothers, actually worked for McNeill. Once they left the B&O, McNeill came north to the Boston area to build a railroad that, basically, is now part of the Northeast corridor. It's the road between Boston and Providence-- and did the surveys on that, even those these two young were basically interested in geology, McNeill hired them to help with the survey team, and then, on the side, he encouraged them to do geological explorations of the area, which they did. And they loved it.

And they got to really admire these army engineers, so much so that they really seriously thought about becoming engineers themselves. That didn't happen, primarily because they felt that army engineers had such an inroad into the engineering business at that time, they were really the only serious engineers in the United States, were these West Point trained people, that they didn't think they had much of a chance getting the good jobs compared to what Whistler, and McNeill, and others were getting as a result of their connection with the Army.

Both Whistler and McNeill left the Army in the 1830s and became private, consulting engineers. And Whistler went on to engineer not only the Western branch of what became the Boston and Albany railroad, which was the first major railroad to go over a serious mountain chain, the Berkshire mountains. If you drive west on the Mass Pike and go up over the Berkshires toward Albany, New York, you're going exactly through the area that Whistler ran a railroad through during the mid 1830s, late 1830s-- serious elevations there.

And he did it. He got a lot of attention for doing it. And one of the groups that paid attention to him were these Russian engineers that were sent to the United States by Tsar, I think it's Nicholas. It's either Nicholas or Alexander, but, in any case, he was--

DAVID KAISER: Weren't they all Nicholas or Alexander?

PROFESSOR: Nicholas and Alexander, you've got to be one or the other. I can't be far wrong on that one. But in any case, he was hired by the tsar to go to Russia to engineer what is now called the Moscow and St. Petersburg Railroad, which he did. He died in Russia, of cholera, in 1849. But his body was brought back to the United States and

buried down in Stonington, Connecticut. I have visited his grave. And I can attest that George Washington Whistler now lies in Stonington, Connecticut.

But he was a great engineer, and he was an important here. He had a lot of influence on Rogers and his brothers. And as a result of that, as I said, they both contemplated engineering careers but then backed away and decided, no, we are really educators. We're interested in this new field called geology. Both William Barton and his brother Henry Darwin Rogers became very, very eminent geologists. In fact, Henry, his younger brother, actually got an appointment at the University of Glasgow as a chaired professor there during the-- I think it was during the late 1840s, early 1850s.

And it's in the process of experiencing these things with these new railroads and industrial ventures that really begins to turn his head toward these "useful arts" and to think about how are they related to the sorts of scientific interests that he has. The other experience that he had that's very important in all this was that when he was teaching at the University of Virginia in the 1830s he was appointed the head of the state Geological Survey, and I've written about that in the essay, in which she had a miserable time because of the political interest that were vying with one another.

He conducted the survey. He completed it, but the results of the survey, which were important, were never published because the legislature was bickering among themselves-- sounds familiar-- about the costs, whether it was a worthwhile project, the whole thing you might imagine. But in any case, Rogers was disgusted with Virginia. Surely, by the late '40s, he was really disgusted with the whole state legislature and political process there.

But in conducting these surveys from one end of the state to the other, and in those days, Virginia included the current state of West Virginia, not just the current state of Virginia. It was a big state. He got interested, basically, in things like mountain formations and very much interested in where mineral deposits were located and things like that. But the big problem was finding assistants that could help him

conduct the sort of geological work that he needed to do in order to finish up the survey and make a report. And that was another stimulus toward his interest in trying to do something with combining science with the useful arts.

So those are, I would say, two critical moments during the 1830s in which he really began to begin to think about establishing some sort of what we would call a Polytechnic Institute, or Institute of Technology. He and his brother both started talking about this as early as 1829 in Baltimore. But then it got continued throughout the 1830s and well into the 1840s. And that's really how the whole idea of what this place is about got started.

Rogers also saw, through these years, that there was a crying need for people to do engineering work and meet what he referred to as the "wants of the age." This was the great field, the open field-- lots of jobs and possibilities for advancement. And he saw that, and, again, it stimulated his interest in education.

So as a result of this, he develops a plan for a Polytechnic Institute, the first draft of which, I think, was written as early as 1829. And then over the next 30 years he and his brother sort of elaborate on this plan about how would they organize it? What disciplines would be included? But the key, I think, the key idea that they developed over these years was trying to combine, trying to develop an educational system that would combine science with the useful arts, make them relevant to one another and especially inform the useful arts about what science could reveal to them-- the understandings of chemistry, or physics, or whatever.

And of courses, as you've read, the finality of this comes in 1861, when he receives a charter from the state of Massachusetts to establish what is called the Massachusetts Institute of Technology. Now in that, he'd had to do a lot of lobbying. He had learned how to work with politicians through that miserable Virginia experience. I think it made him a wiser man-- maybe a cagier person in terms of learning how to work with politicians or to get around the obstacles they put in this way.

It's during the early questions about the charter for MIT, for example, that the

governor of Massachusetts, who was a Harvard graduate, first proposed the idea of, why create this MIT as a separate institute? Why not combine it with Harvard? It's one of those early questions about, well, why not combine it with Harvard rather than make it a separate institution? Rogers resisted that throughout this entire life. And there were several other attempts made during his lifetime to try to merge MIT with Harvard. But it began very early. And it began first with the government of Massachusetts, who would like to have seen that sort of combination put together.

But once they got the charter, the big challenge then was to try to get the place going. And the problem was that he got his charter in April 1861, and what happens in 1861, in April? Civil War. And so a war breaks out. It makes it difficult for him to raise money, basically-- very difficult to raise money.

And some scholars who have studied the history of MIT think that maybe it was a good thing that there was a war, in terms of his interest, because it gave him time to complete this plans and to work the political process in a way that allowed him to eventually get the Institute started in 1865. There may be some truth to that, but I think the real problem that he faced 1861 was money. And that was a problem MIT was going to face for the next four years or so.

MIT was always running in the red, basically, well into the late 1890s and probably beyond that. I just haven't studied that much beyond the fiscal situation beyond the 1890s. But in any case, he got his charter. He has to hire faculty. He has to choose and acquire a site to initiate classes in. He has to raise this money. There are a lot of things that have to be accomplished.

And I think one of the big godsend of the period was that there was a law passed in 1862. It was a federal law, part of the Lincoln administration's political agenda called the Morrill Land Grant Act. And I remember reading about this when I was your age and being totally bored by it. But it turns out that that is a very important piece of legislation because it led to the establishment of what we call the land grant university system in this country.

All the big state universities, basically, are related to that land grant act. Some very

directly, and others less so, but, nonetheless, most of them-- Texas A&M, Penn State, Ohio State, Michigan State, Wisconsin, Berkeley, you know, you can go across the country and almost choose. In every state, there's at least one institution that was founded under the Morrill Act.

Well, that Morrill Act was passed in 1862. And basically, what it said was that for each congressional representative that you had in the US Congress, the state would get 30,000 acres of land, which it in turn could convert into script and sell the script, or the rights to the land, as a way of raising money to establish agricultural mechanical colleges within the state boundaries-- A&Ms, if you want to call them that.

So Massachusetts, I think, had 10 congressional representatives and two US Senators. So it got a fairly sizable chunk of land in the Midwest. If I'm not mistaken, it was out in the area of northern Iowa, southern Minnesota, in that area, where a lot of this land was located. People in Minnesota and Iowa, by the way, were not happy that the federal government was giving away land in their states to states that had nothing to do with them. You can imagine how people in Minnesota must've felt about this huge chunk of land going to New York State, or Massachusetts, or wherever.

But in any case, that converted into substantial funds that were used to found not only MIT but also the University of Massachusetts at Amherst. And basically, MIT got a third of those monies over a 30 year period. It was given to them in increments. They got a sizable amount of money, well over \$300,000. That may not sound like much today, but if you convert it into 2008 dollars, it's a big hunk of money. I don't know but I've--

DAVID KAISER: Well, it would put you through MIT today.

PROFESSOR: It would put you through MIT today. That's a good way to put it. Yeah, so it's a sizable amount of money.

DAVID KAISER: Plus a couple vacations.

PROFESSOR: But probably just as important as the grant from the state itself, which consisted not only of money, but also of land, over in the Back Bay-- MIT was first established not here, where we are today, but over in the Back Bay near Copley Square. If you're familiar with that area, the original building was very close, block or two, from Copley Square. And it stayed there until 1916, pretty much. But in any case, the money for all that came from the state of Massachusetts.

So the state was important in all this. Without the state, I would, in fact, question whether private donors would have stepped forward to donate money to MIT because they weren't sure about its future. But when the state began to invest in MIT, that sort of gave a signal that, yeah, MIT's got a future. I'm going to pony up some money and give --and one of the big donations that came very soon after MIT got the state funds was a donation that I begin my essay with, this doctor-- what's his name--

DAVID KAISER: Walker?

PROFESSOR: What is it?

DAVID KAISER: Walker.

PROFESSOR: Walker, yes. William Walker, a physician who had invested in industry in this state. This was a leading industrial state. And he ponied up \$60,000-- a lot of money for a private individual in those days.

DAVID KAISER: On the last day before the--

PROFESSOR: In the last day, yeah, so it was an iffy proposition from the beginning. And Rogers, I think one of his great skills was as a, in a way, small p politician, a lobbyist. He was very effective at lobbying people, and raising funds, and keeping this institution going from one year, literally, one year to another. Because every year, as I said, it was running on the red. But he made it go.

DAVID KAISER: Something about Back Bay, too-- because maybe not everybody knows that what is now Back Bay was once a Bay.

PROFESSOR: Absolutely.

DAVID KAISER: And I hadn't really remembered until I was reading the reading last night that part of the initial interest was-- they filled in the Back Bay to make what is now Back Bay, which was a huge engineering project in and of itself. And then there was interest in using that land for educational purposes, which Rogers then sort of satisfied to some degree.

PROFESSOR: Right. And I think I mentioned in the essay that the initial proposal was not just for an industrial school, MIT, but was also for a natural history museum and a society of arts. It was a 3 part combination that was initially proposed. And eventually, of course, MIT was the one that really lasted. And the other two sort of slipped by the wayside.

But in any case, that's the story of the beginning because, I think, in the early days, if I'm not mistaken, that one of the early courses at MIT was in mining and, what's the other--

DAVID KAISER: Metallurgy.

PROFESSOR: Mining and metallurgy. And in those days, geology would've been lumped into that area. And then later, it becomes-- yeah, yeah. Now, I can't absolutely swear that's the case, but that's my-- what would say say, an educated guess, I guess, would be. So to look at Rogers and just say, OK, what are some of the important points to remember about him?

One is, he's a good lobbyist. He keeps the place going. He keeps the vision alive, OK? And secondly, there's the vision itself. You see it on the great seal of MIT. You know, interestingly, if you look at the seal, it's interesting. It says mens et manus-- mind and hand. Science and the useful arts, another way to think of it. But clearly, that vision of the combination of science and the useful arts was there from day one. And that seal was actually approved in 1864, if I'm not mistaken Rogers was on the committee that, you know, approved that seal. And he obviously played a role, I mean, I think his vision is sort of stamped, literally, into the seal itself, of what

this place was going to be.

One curious thing about that seal, however, I'll point it out now. It's not original with me, but a colleague of mine, years ago, pointed it out to me, and I have thought about it ever since-- was that when you look at this seal, you have a craftsman, or an industrial worker, and a scholar, OK, the scientist and the useful arts standing next to a pedestal, and then the words *mens et manus* below, and the date of the founding of MIT.

The interesting thing though is that, in Rogers' vision he wanted to combine, he wanted each of them, science and useful arts, to inform one another. That was the special thing, the idea that he had. This was a new way of educating people. And yet these figures, science and engineering, or science and useful arts, they have their backs turned to each other, as if they're not conversing at all. Curious. I don't know if it was for aesthetic purposes or what, but from a didactic point of view, they should have been facing each other, and having discussions, and interacting. Clearly, they're not doing anything. They're sort of both in their own worlds. And that's an interesting comment, I think, just on the seal, not necessarily about Rogers' vision.

But he has this important idea about the combination of the two, which is very important. And in the essay, I put a lot of emphasis on the importance of laboratory education there, in which students are not just being given lectures and demonstrations by the professor using the apparatus, but, in fact, they're allowed to go in and perform experiments themselves using the apparatus.

One of the reasons why MIT was constantly in financial difficulty was the need to maintain the laboratories that were so critical to the education of its students. Laboratories are very expensive, to this day probably the most expensive item in the MIT budget, I would think-- one of the most expensive ones.

Look around us at these new buildings that are going up just in the biological sciences and think of the expense that has been invested in them. And it was no less true in the 19th century. And it had a special meaning for Rogers because he

wanted students to be immersed in that experimental process and not just lookers-on. He wanted them involved in the process. And I think that's one of the really distinctive things about MIT, then and today. I keep thinking that vision of 1861, 1864, of Rogers can be seen in the UROP projects. And several of you have written in your reflections about this today-- different programs that exist at MIT that have that sort of active involvement of students that, in the days of the 1860s, just didn't exist at other places, or surely not to any extent like it did at MIT.

The other thing that Rogers had was an eye for talent. Every great leader needs to surround themselves with capable people. And the more capable, the better. And Rogers, I don't know if you want to call it good fortune or just the ability to spot people and hire them. But he hired a very talented staff.

I think there were something like 20 professors, maybe not even 20, by 1870, five years after classes started. But at least half of them were very, very competent people. And two of the most important were a guy named Francis Storer, S-T-O-R-E-R, and somewhat younger guy, but not a lot younger, Charles Eliot, both of whom were chemists, both of whom were Harvard educated, and, it turns out, both of whom were brothers in law. Storer married Eliot's sister.

And Storer came to MIT first. He was one of the first faculty hired at MIT, to set up a chemistry department here. And then Eliot, who was studying in Germany, was hired like in 1867 to come in and fill out that enterprise. And they end up building one of the first really experimental research oriented laboratories in the United States, academic, anyway. And they also are the first to write textbooks for the study of chemistry, and chemical experiments, and things like-- two very famous textbooks that were published during the early, well, the late 1860s and early 1870s. So they're important people.

Now the interesting thing is that Eliot was at MIT a very short period of time. He came and '67 and he left in '69 to become President of Harvard. And interestingly, it's Eliot who really initiates all these attempts to merge Harvard with MIT. The essay that you read today called, "The New Education," same guy, Charles Eliot, the

author is Charles Eliot. He wrote that while he was at MIT, but the same year that essay was published, he becomes president of Harvard. And immediately, he starts making overtures to William Rogers about, come on, Bill, let's-- I don't know if they'd call him Bill.

I've often wondered, what did they call William-- did William Rogers have a nickname? We had a reunion over in Burton-Conner about two or three weeks ago, and they had this big cut out picture of Rogers. And one of the students from Burton-Conner came over and clipped a little ID badge on him saying, "Billy." But I can't imagine, William Rogers, does not strike me that you would walk up and call him Billy Rogers.

I don't know if he had a nickname or not. But in any case, Eliot liked--

DAVID KAISER: Mr. Rogers.

PROFESSOR: Pardon? Mr. Rogers, that would even be better. Yeah, Mr. Rogers.

DAVID KAISER: And they called MIT Mr. Rogers' neighborhood.

PROFESSOR: Well, you're just full of neat observations today.

DAVID KAISER: That's my job, [INAUDIBLE]

PROFESSOR: That's good. That's good. You remind me of Waldorf over and-- you know, the muppets up in the balcony?

DAVID KAISER: [LAUGHS]

PROFESSOR: You're Waldorf today. Anyway, Eliot really liked what he saw at MIT. He clearly thinks that MIT is the core of this "new education." This is where the action was at. And he tried very hard during his presidential years at Harvard-- and he was president of Harvard for at, what, 35 years or so? A long time. Never happened. But that was one of his fondest wishes. And he was one of these early hires that William Barton Rogers made here. Clearly, he had sold Eliot on the MIT vision.

There were others. Edward Pickering, like Eliot and Storer, established a very famous lab in physics here. And he was literally Rogers successor as the teacher of physics at MIT-- again, another Harvard graduate. All these early professors are pretty much Harvard graduates who came to MIT and then, like Storer and Eliot, often left MIT to go back to Harvard, interestingly. I don't know exactly why. Eliot was a very persuasive person, but I'm sure Harvard could shake a lot more money in their faces, too, in terms of salaries and things like that. That's probably important, an important attraction.

So Pickering, as I recollect, also returned to Harvard at one point in this career. But he was a very important laboratory builder here at MIT that established, again, the MIT model for spreading this new vision of education around the country. And then finally, in architecture, another Harvard graduate, William Ware, establishes the Department of Architecture at MIT. It's the first in the country, and very successful, very much oriented towards this hands on, laboratory oriented design process in architecture. He was at MIT for about 15 years. And then he leaves to go to Columbia and establish a similar school at Columbia. He's considered the leading educator in architecture of the late 19th century.

So you have here, in this early faculty, some very interesting and significant people. And I think the important thing, for the purposes of our discussion today, is that Rogers hired these guys. He had an eye for talent. And there's nothing like having great talent around you to build a great institution. And that was underway by the 1870s.

People were actually writing to Rogers by the 1870s, like, within five years of the founding of this place, saying, MIT is making itself heard. And that reputation continues to gain momentum throughout the decades of the late 19th century. So much so that in the paper that I wrote, I refer to Francis Amasa Walker, who was the third president of MIT making his annual report in 1894, in which he comes out and says, basically, thanks to the founders of this Institute, and especially to William Rogers, the battle of "the new education" " has won.

Well, the new education meant that MIT had now become the great model of this new way of educating people toward a more integrated curriculum built around science and engineering. That was a new model. And when you look around the country today, virtually every major university has sort of bought in to that model. Even a number of small colleges have, but especially large state universities-- very much influenced by this MIT approach.

Now the final point to be made about Rogers, I think, is that he's one of the country's first geologists, professional geologist. He's one of the founders of the field in the United States. He is also a founder of the American Association for the Advancement of Science. He's not and he's not on the inside of that operation, but he's definitely consulted about it, is an early member, and plays a role in it.

But he is an important geologist in the history of science in this country. And he's also an early defender of Charles Darwin. Darwin's *Origins of Species*, the famous book on evolutionary theory, was published in 1859. And Rogers was one of the first in the Boston area to embrace that theory, and defend it, and argue that it had-- from his geological perspective was a viable theory.

He was opposed, very vigorously, by a zoologist from Harvard named Louis Agassiz, who, in more than one time, tried to do in Rogers, both as a geologist and as the founder of MIT. But, again Rogers had staying power and was able to make its way through all these crises. But I think as a geologist, he often gets forgotten in that area, even though he was an important contributor to that field.

Now what are the take home points of the essay that I wrote. I'll give you three. One is obvious. It's the sustainability of Rogers' vision for MIT-- the mens et manus theme. The idea of combining, bringing together science and the useful arts. It's a remarkable continuity, if you ask me. I think it's something that has maintained itself right up to the present. That's amazing. This place is 150 years old, and yet the founding vision of the place still informs it in many ways.

Now that doesn't mean there haven't been changes. There surely have been. And we'll see them during the term. But that basic concept has maintained itself. That's

amazing to me.

Another thing that's important to note here is the role of the state in the founding of MIT, the fact that the state of Massachusetts, funded by the federal government, basically, put up a lot of the real seed bed money that was used to get this place started. And then that, in turn, attracted private donations to MIT. But as late as the 1890s, MIT was petitioning the state of Massachusetts for increments of \$25,000 a year, simply to try to support the building of labs and stuff like that.

So Massachusetts have a long history of involvement with MIT, even though this was supposedly a "private corporation." It's curious. It's a land grant school that is a private corporation. Not many were like that. Most were state universities that were state controlled and did not have this word corporation. You might have been a member of the board of trustees, but you were not a member of the corporation like we have today. So again the state is important here.

And then finally, just about MIT's significance, it's the new education that's important. It's a new breed of cat that's being developed here, and it's one that had legs. It's probably had, I suppose, this sounds so much like a homer lecture, but it is, in a way. I'm enthusiastic about the history of MIT. Maybe it's because I haven't learned enough about it yet. But the vision for MIT had an impact. It made impacts elsewhere. It continues to have that.

We'll talk about, later in the term, about how the MIT model is now being exported to Singapore, and to India, and all over the world. So it's had enormous, enormous impact. And that's not something to be sneezed at. And it's really why Charles Eliot wrote that essay called "The New Education," was to point out, this is something new and different. This is worth attending to. And he does a survey of all these various schools and says the real place where the action is is MIT.

That's 1869. Within months, he was going to become president of Harvard and, as I said, made numerous attempts to try to bring MIT into the Harvard fold, unsuccessfully. So David suggested that's my remarks, OK. Brilliant. Aren't they? Eli, you thought they were pretty good, huh? That's good. I know all these people.

So you're wondering, why is he talking to them, you know?

Anyway, David suggested, before the class started, that we take a closer look at Eliot's piece "The New Education." I debated about whether we should have you read this or not because, frankly, it's pretty boring. It's not an easy piece to read. It's written in a very stilted, 19th century style. And yet it says things, if you can make your way through it, it does say things, I think, that are important to note.

And so, this is basically Charles Eliot's take on the state of education, higher education, in the United States circa 1869. That's really what this essay is about. And the big distinction he makes is that he talks about how there are basically three different types of higher education institutions in the United States. There are the classical colleges that teach Latin and Greek, mathematics, the typical curriculum aimed at cultivating an educated gentleman for society. That's where gentlemanly people went. Ladies, I'm sorry, were not admitted to those schools in those days.

Most women, in those days, if they went to college at all, and many of them did not, went to-- my grandmother, who went to one of these college called state teachers institutes, or educational institutes. But rarely would you see women on the campus of Yale. I don't even know if Yale admitted women, did they in the--?

DAVID KAISER: 1969.

PROFESSOR: Wow. See? It's a good-- OK. Well, Harvard had Radcliffe. So they're next door neighbors, but there's this divorce that exists. Now, interestingly, Rogers, from day one, said we will admit women to this place. A very, very small number came. And most of those who did come were called special students. They were not regular students like you are but rather special students who were part time, basically, part time students, women who were working in the area who wanted to take a chemistry class or something, could enroll here. But for it's day, that was quite a revolutionary and open minded thing to do, I think. But he was very open to that.

He was very much a reformer, I think. He was involved in the abolitionist movement. And David pointed out today that one of his friends from Virginia, a guy named

Edmund Ruffin, was actually one of the first to fire the Confederate cannons on Fort Sumter in 1861. So here's this man coming out of Virginia who was imbued with this slave oriented ethos that's pervaded Virginia prior to the Civil War, who was open minded enough to see the problems and downright evils of slavery, resist them, and, eventually, remove himself from the South and come to New England. That's one of the reasons he moved here. He was just so sick of the violent society that Virginia had become by the 1850s, especially around slavery. A lot of his problems came from that direction.

Well, when Eliot writes about "The New Education," he doesn't use that phrase a lot in here. You really have to kind of look-- he may have mentioned the term new education or some variant of it maybe three or four times in the entire essay. It's not something he's pounding away at. But he's making as interesting comparisons, first, between these three kinds of institutions that are trying to organize educational framework around the useful arts and science. And he argues that two of them are just abject failures, basically, there are schools like the Lawrence School at Harvard, or the Sheffield School at Yale, or the Chandler School at Dartmouth, that make the attempt but can never quite achieve what is needed to be done because their faculty come from the school itself. And as a result, the faculty loyalties and the degree of involvement in these new ways of educating students is never complete. It's always sort of a halfway process. And that's something that bothered Eliot a great deal, especially about Harvard because the Lawrence School was heavily endowed for its day. And yet it had really had a sort of a meager record of turning out students who were well educated in the useful arts. And so that's a problem.

There are other types of colleges that he talks about with reference to the useful arts, smaller schools like Union College up in Schenectady, New York or Brown University down in Providence. And basically, the argument is somewhat similar there, is that it's hard to introduce this new concept of combining useful arts and science in environments that have been completely oriented toward the classical education up until that time. It's very difficult to do that. And as a result, he says, it's really to the third type of school, the RPis, the MITs, are the two main ones where this model is more likely to succeed.

And there, he says that RPI's been quite successful at it. It's really the first civilian engineering school founded in the United States. It dates to 1824. And RPI is basically a place that trains civil engineers. It does not get into mechanical engineering or metallurgical engineering, things like that. It's strictly oriented toward civil engineering-- by the time the Civil War, very successful. But it's really to MIT that he looks. And he says now here is the model because it's so open to educating not only civil engineers but mechanical engineers, architects, metallurgical engineers-- MIT has a menu by the late 1860s that no other school really has. And so that is, I think, a distinctive comment that he makes.

But basically, I read this, and for me the takeaway is that Eliot loves MIT. He sees MIT as the new direction for higher education and that's doing something different than any other place has ever done. It's a good question. The interesting thing, I wanted to note, here, though is that on page 216 near the end, yeah, he's talking about RPI and MIT, but he makes no reference to the US Military Academy, which is arguably the first engineering school in the United States. It's modeled after the French Ecole Polytechnique-- except for a footnote at the bottom of 216. Did you see this note?

He says the United States Naval and military academies are not referred to at length because-- they're not refer to at all, basically, because access to them is not free. A thoroughly vicious system blah, blah, blah. He does not like the military academies. But he completely erases them from the essay. Did you have your hand up?

AUDIENCE: Um, not really.

PROFESSOR: Huh?

AUDIENCE: No.

PROFESSOR: Oh OK, I thought you were waving your hand going, I object! He's just anti-militarist, or something. But those are important places-- especially West Point. In fact, I think

I say it in my essay, that the president of Brown University, Francis Wayland, made a comment in the 1850s that West Point had trained more engineers than all the other colleges in the United States put together. Well, that says something. It's not a big school. And it also tells you about the need for more engineers in the country because West Point could not produce all of these people. Hence the reason why MIT became so important by the later decades of the 19th century.

And where did early MIT graduates go to work? Many of them went to railroads. That was the big industry after the Civil War. And many of them go into the railroad industry as managers, engineers, railroad builders. Many go into chemical industries that are beginning to emerge during this period too. It's interesting, for example, that the du Pont family sends the best and brightest of their family, of young people, up here to get educated. Pierre du Pont, one of the really important industrialists of the early 20th century, is a graduate of MIT class of 1890. And there were other du Ponts that came here, too, but he's probably the most important.

And Arthur D. Little, famous AD Little Laboratories. I don't know if they're still, are they still in operation? Private research laboratories in chemistry?

DAVID KAISER: I believe AD Little is still in operation but they sold off the R&D lab--

PROFESSOR: They did, OK.

DAVID KAISER: To an MIT alum, actually, Kenan Sahin, owns it now. And it's got a different name.

PROFESSOR: Oh, he did? OK. Well, there's a list of very eminent engineers, chemists, applied scientists that are coming out of MIT by the 1890s that go on to really play a big role in the commercial development and industrialization of the United States in the 20th century. So MIT has had an impact. I don't know if you want to say any more about Charles Eliot's piece here.

DAVID KAISER: I would read through little bit of it in detail.

PROFESSOR: Go ahead.

DAVID KAISER: How many people brought the piece

[INTERPOSING VOICES]

PROFESSOR: Can you get it off the scholar site?

DAVID KAISER: If you have it, maybe pull it out because it's sort of worth, I think, reading parts of it in some detail because, first of all, it's a good exercise in what we call close reading, were how you-- I mean, the language a little foreign. It's not very foreign, but what's being said between the lines, or what's he assuming that people are saying. And I think some of it is relevant to both what [? Rowe ?] was saying, and even to MIT today. I'm sorry? It is on Stellar, yeah, so if you have a laptop you can find it.

You know, he starts out with this line-- "what can I do with my boy?" Which is very interesting. I mean, obviously it's only boys and men that he's addressed like [? Rowe ?] mentioned, that was the language of the day, up until a couple of decades ago. But, sort of addressed to the parents, and of if you read down a little bit, this is what a parent might say, I want to give my boy practical education. One that will prepare him better than I was prepared to follow my business, or any other active calling. And I like that phrase active calling, because implied there is there are passive callings. I wonder what he means by a non active calling. I would guess he would mean the clergy, or probably law, and he comes back to them a little bit.

And then he says this is a problem that everyone has, but the difficulty presses more heavily-- still in the first paragraph-- on the thoughtful American than on the European. And so he's making a distinction that the conditions of this country are special, in some way, for this kind of education. It's not the modern phrase of old Europe, there are special things here, because the American is free to choose, in a way, a way of life for himself and his children.

And then-- a couple lines down-- in the face of prodigious material resources of a vast and new territory, he is more fully awake than the European can be to the gravity and urgency of the problem. Also a really interesting way to start out at the beginning, that there are special things about this country. That's not a new idea, American exceptionalism, is what historians call it. But, the conditions here are

different than in Europe. Partly because of the huge size of the place. Partly because of the huge amount of resources. And that makes the American more fully awake. And yet, he has fewer options than any other, except possibly the English, of solving the problem.

And then on the next column, he refers to implicitly particularly the French engineering schools. For more than a generation the government schools of arts and trades, arts and manufactures, bridges and highways-- one of the famous French engineering school is Ponts Et Chaussees, the school of bridges and highways-- Ecole Des Mines-- another famous French engineering school-- mines, agriculture, and commerce have introduced hundreds of well trained young men. They begin as subalterns, basically low people on the totem pole, but soon become the commission's officers of the army, and of industry.

Which is interesting too, what is the problem that the European engineering schools are feeding? They don't have vast territory remaining, they don't have vast resources in their countries, where are all those engineers going, if in the US they're going out west? Into the colonies. It's a problem of maintaining the empire. He doesn't talk too much about, he does use the word empire in there, but in a way he's sort of arguing that America has its own empire right here, and French particularly, German, English, they're all building railroads in the colonies, a little bit more in the later 19th century.

PROFESSOR: Think, for example, the British and India, huge, huge, and that's only a part of the British empire in that period. It's a huge empire.

DAVID KAISER: Then he this great line, The American people are fighting the wilderness, physical and moral. Which is funny, it's also interesting, this is four years after the Civil War. In fact, most of the stuff we've been reading, relatively recent, doesn't mention the war in here. You have a country that just lost the better part of a million people. The South has been destroyed to a large degree by the war. The young people's population has been destroyed. I don't know, what was the population of the US in the time of the Civil War?

PROFESSOR: I want to say it's around six million maybe?

DAVID KAISER: So six million, even if you lost six--

PROFESSOR: I'm not sure.

DAVID KAISER: --hundred thousand people out of that. 10% of the population. Extend that out today, that's like you having a civil war where you are losing tens of millions of people. Nobody would have been unaffected, and he doesn't mention it in this piece, which is also very interesting.

PROFESSOR: I know one thing, the South lost 25% of it's younger men during that war. 25%--

DAVID KAISER: That's huge.

PROFESSOR: --that's a big, big, [INAUDIBLE]

DAVID KAISER: The American people are fighting the wilderness, physical and moral. So, you wonder what that, physical wilderness is obvious, moral probably is referring to the, I would imagine, the Western wars and--

PROFESSOR: Yeah.

DAVID KAISER: --fighting the--

PROFESSOR: Indians.

DAVID KAISER: --Native Americans there. And that's his vision of the battle. At the same time, trying to work out the awful problem of self government. So he's tying these basic ideas about education to both the physical state of the country, and also the ideological and government state of the country.

PROFESSOR: One thing to note in all that is that William Tecumseh Sherman was a very famous Civil War general, he's the one that burned Atlanta, and did the famous march to the sea, was asked during the 1870's, what he thought about the quote "Indian problem" Here's this movement west, and the part of white settlers. He says, nothing to worry about, we're building railroads in the West and that's driving a

stake into the heart of the American Indian, or something like that. That was going to do them in, is the engineering of these new railroad technologies, is just going to overwhelm them, and it did basically.

DAVID KAISER: So down in the bottom of that column he talks about all these frustrations, but he knows the greatness of the material prizes to be won. So it's not an appeal for moral elevation necessarily, or this and that. It's an appeal for material prizes, which is very much on the mind of Americans, since the founding

On the next page, just interesting phrases on the top left, on 204, These old ways have trained some boys well, for the life of 50 or 100 years ago, And the American will not believe that they are applicable to his son. For the reason that the kind of man which he wants a son to make, did not exist in all the world 50 years ago. This was 1869, and somebody mentioned in one of their response papers that they appreciated, from the reading, how close the revolution still was, in that most of the fathers of these people would have been directly involved in it, which is correct. So, 50 or 100 years ago there's been all this political upheaval and America was a very agrarian society, but everywhere was, and he's really referring to what we now call the Industrial Revolution there. Entirely new kind of people are required.

Then also down in that column, I think this is very interesting too, it requires courage to quit the beaten paths in which the great majority of well educated men have walked, and still walk. So he's basically saying, and you even still hear this to some degree today, the MIT graduates especially if they're successful, will enter a world where everyone knows Latin and Greek. Everyone knows different kinds of history. Everyone is going to be extremely well versed in theology, and these other things, and MIT graduates, for the most part, won't be.

But he refers to it as courage to go into that world with this new kind of training, because it will be so rare, it certainly was rare at the time. Frankly, it's still rare, as you'll find what you graduate. And that he talks about a special kind of courage that's required. And down at the end of that paragraph, even more, a boy who was brought up in a different way suffers somewhat, both in youth and in manhood, from

the mere singularity of his education, though it may have been better than the common.

I found that really interesting to read. I never thought about this kind of education as courageous, or the kind of people who are educated, as taking that on. Because you will be an anomaly, you may not be if you go work for a very highly technical corporation in the engineering part. But, most corporations, even the very highly technical ones, as you rise up the people are less and less engineering educated, not to mention in the general social world.

Then he talks a little bit about the organization that Roe mentioned on the next column. A large number of professors trained in the existing methods, hold firm possession and transmit the traditions they inherited. And I just thought that was an interesting word, inherited. Because again, he's kind of trying to overthrow European model of inheritance, comes back to that in a minute, and again the American model is one of earning it. And he talks here about how stodgy these old systems are, backed by the reputation of their authors and the capital of their publishers. Steadily fed by schools whose masters are inspired, these are the older schools, and all the so-called learned professions, I love that kind of language. Again, I think that's really a dig at, probably, both the clergy and the legal profession, maybe some others as well.

Also, makes a distinction between, it's an interesting thing about, that none of the MIT founders have any problem teaching languages. Which is interesting because one of the few things that was required then, that's not required now, which I'm not sure is the greatest idea, but it's the living languages versus dead languages. Especially, then if you don't read French and German, you can't read engineering literature basically. It's not so true today. German was, for many years, the real classic engineering literature. But just not Latin and Greek.

And then there's a great line on the top of the 205 where he talks about, again, the old style educators. To have been a school master or college professor 30 years ago only too often makes a man an unsafe witness in matters of education. It is just

a great metaphor. There are flanges on his mental wheels which will fit only one gauge. What is that a reference to? It's a railroad analogy. So he's using these sort of technical analogies to make his point about the education.

Then he talks here, again, also sort of a dis at the kind of great professor model of education. In no country is so little attention paid by parents and students to the reputation of teachers for genius and deep learning as in our own country. Faradays, Rumfords, and Cuviers-- these are the famous European professors-- would get very few pupils here if they're teachings were unmethodical and objectless. If, in short, they taught under a bad general system. Spasmodic and ill-directed genius cannot compete in the American community with methodical, careful, teaching by less inspired men. Very interesting argument to make. I'm not sure if everyone would agree with that today necessarily, but obviously we don't want to have spasmodic and ill-directed directed genius in front of the classroom.

But, it really is very much an argument about order in education and sort of focus on what's empirical. And I think that's a really important component of a lot of the background here, we haven't said anything about the Enlightenment yet, in this class. Anybody heard that phrase before? Usually associated with the 18th century, late 17th, most of the 18th century, into the early 19th. But, one of the great focuses of the Enlightenment is empirical learning, not just theorizing, not just the sort of platonic philosophy of working as the ancients through a set of reasoned arguments, but, actually gathering data from the world.

Now, what's interesting about that, is there's sort of a split that you observe where if you look at someone like Louis Agassiz who Roe has mentioned, the great Harvard natural history professor at the time, very much an enlightenment empiricist, in the sense of Natural History. Has anybody been over to the Harvard Natural History Museum lately? What kind of a museum is it?

AUDIENCE: It has a lot of rocks.

DAVID KAISER: OK, a lot of rocks. What else?

AUDIENCE: [INAUDIBLE]

DAVID KAISER: What? Animals. It's a kind of, old-fashioned, glass case museum. Right? Very typical, not what you'd find, I was just at the Natural History Museum in New York, which is used to be that kind of museum, and still has pieces of it, but is a very different kind of museum. But the Harvard museums are sort of lovely and wonderful in this way, but there's cases and cases of specimens, whether they're , plants, or stuffed animals, what's the correct word? Taxidermy. I brought my daughter there actually, she liked the stuffed animals. Animals, plants, geological specimens, and that's very much the kind of natural historical world that Louis Agassiz represented.

There, the empirical philosophy was one of collecting, ordering the collection, everything's very carefully labeled. Very carefully name with a very fancy Latin name. Often then numbered, drawers and drawers, taking the world classifying it, putting it into a hierarchy. You're familiar with the Linnaean hierarchy of the natural world. Very much an enlightenment practice, but slightly more, kind of, 18th century version of it that Agassiz, sort of, still represents into the 19th century.

Rogers, in his reaction against that, is in a way, kind of even further, more radical enlightenment. What's different about the kind of world that he would think about? Let me give you an example that maybe you could set off. I was reading last night an example of a student who said, when I went to work for Louis Agassiz at Harvard as a student. Basically, he locked me in a room with 500 tortoise shells and no supporting anything, and my job was to discern the inherent truth of nature that was collected in those tortoise shells. What's the kind of world, the way that Rogers and an MIT approach to that problem might use? It's also very empirical, collecting information from the world. So it's not that what he's reacting against is not empirical.

Well first of all, intervention by active experiments. You're not just collecting the world and putting it in glass cases, you're often physically out in it, collectors were doing that too, but your making changes to it, putting things on, and also enhancing

your senses by using instruments. He was a great fan, Rogers, of new kinds of instrumentation and the uses of these kinds of instruments. They might be spectrometers, spectrographs, or obviously microscopes, but other kinds of photometers and things. And a much more kind of, you might call it high-tech in a way, but also very active intervention in the world of nature, the physical world, the things you're going into. It's not a world of collecting and classifying, and discerning this inherent underlying truth from. It's a world of very active, and again, as much for the students as for the researchers in his world. Which says something about why he was such an admirer of Darwin. Yeah, very much so.

PROFESSOR: It's a world that's evolving.

DAVID KAISER: There's a nice story, which we haven't really told about, when Rogers finally gets the charter for MIT, and the war starts. And Massachusetts gives him one year to come up with \$100,000, which is then later extended to two years and he almost doesn't make it except for this big gift from [? Walker ?]. And so he's figured, OK great, now I'm off and running, I've got all this time, the war is probably going to delay our plans a minute I can just go raise money. And the governor comes back to him and says, oh, and by the way, I would really like you to become the inspector of gas in Boston. And gas, at the time, is the new high tech way to light your home, and it's a technological systems, there are pipes being run under the streets in the city. But it's very dangerous, because as still today, gas is explosive. Probably every few months, a house in the Boston area blows up because of a gas leak.

And Rogers says, no way, I can't take the time out to do this. This is crazy. And the governor calls him in for a one on one, and we don't really know what was said, but he walks out of there convinced that he's going to do it. So he takes on this job. And soon he finds that the instruments that he's been given to inspect the gas, probably the quality of the gas, and different chemical composition of it, and the different illuminating capabilities, and maybe measure leaks and things for safety, are inadequate for him. So he re-engineers, and re-designs a number of the instruments.

And then he begins to see that this is actually a very valuable thing for him because he uses the states money to buy the latest instrumentation. He has very close contact with industry, and it gives him insight into what the latest kinds of instrumentation should be that the students at MIT, that he would then buy for the laboratories as they're outfitting laboratories.

And it's a nice little story, partly because of the kind of ethos of presidents of MIT doing national service, or in that case they service, which is something we'll talk about later, starts at the beginning. But also because it gets him out in the world, get him involved, and he's very much a fan of instrumentation. Even though you think about geology in the 1830's and '40s is not a ton of instrumentation associated with that, although certainly there is in surveying. It gives you the sense of him as not simply a scientist, but also quite a tinkerer.

A couple other things to point out in Elliott essay. I found it interesting because I actually went to Yale as an undergrad, and studied engineering. So, I could see why he thought that was all the wrong model, although he praises it a little bit. But, at Yale the school he was writing about, The Sheffield Scientific School, which was a very famous science and engineering school, doesn't exist anymore. It was closed down by the Yale faculty in the 1950s. So, it sort of supports his case that, that kind of model and The Lawrence Scientific School doesn't exist at Harvard either anymore, that that kind of model is the wrong model, and not really destined survive as a second class citizen there.

But there are a couple other interesting pieces I want to point out. He talks on page 215 about, and this a good reminder, 216 on the bottom and the left, he says, when the American University emerges, it will not be a copy of foreign institutions or a hotbed plant. But the slow and natural outgrowth of American social and political habits. An expression of the average aims and ambitions of the better educated classes. That's interesting because you think we've been spending all of our time you're talking about the emergence of an American university, and the whole issue vis a vis Harvard. What is he referring to there?

Well, it's worth keeping in mind that everything we've been talking about, so far, is really about college teaching. Harvard College is still Harvard College at the time. I don't know when they changed their name to Harvard University. He says the American college is an institution without a parallel, the American University future tense, will be equally original. MIT is not a university then either, some people think it isn't today, but I don't think that's really right. But what's the difference between a college and university? Simple crude distinction.

AUDIENCE: [INAUDIBLE] have more colleges.

DAVID KAISER: Sorry?

AUDIENCE: Universities have [? several ?] colleges.

DAVID KAISER: Some do, not all. Graduate education. So that's actually the first, does anybody know what the first university is in the United States? Johns Hopkins actually. And it's founded late 19th, early 20th century. Where you really have the idea that there's research and graduate education, combined with a college.

So it's just worth keeping that in mind, as we move forward in time, and MIT does become a university. I mean if you read rankings, everybody thinks of it as a university. There are people here still who say, no it's a technical institute, it's not a university. I don't think there's really too much to be argued for that, but arguably MIT only really became our university, in that sense, about 20 years ago. It's not an old thing. But the graduate model, the American University that he is referring to, is really still 40 years away when he's writing this in 1869.

Then I just thought there was a great passage on 218, on the right column, which also have an amazing, and truly MIT metaphor. People who think vaguely about the difference between a good college and a good Polytechnic school are apt to say, that the aim of the college course is to make a rounded man, with all his faculties impartially developed. While it is to express object of a technical course to make a one sided man, the mere engineer, chemist, or architect. Two truths are supported in this form of statement. First, faculties are not given by God. Sorry, two truths are

suppressed in this form statement. He was arguing against it. First, faculties are not given by God impartially, to each round soul a little of each power. As if the soul were a pill, which must contain its due proportion of many variance ingredients. To reason about the average human mind as if it were a globe, to be expanded symmetrically from a center outward, is to be betrayed by metaphor. Then I love this. A cutting tool, a drill, or an auger would be a juster symbol of the mind. If there's not a great MIT statement, I think it's that one.

PROFESSOR: That's good.

DAVID KAISER: The natural, best, and particular quality of everybody's mind should be sacredly regarded in his education. The division of mental labor, which is essential in civilized communities, in order that knowledge may grow and society improve, demands this regard to peculiar constitution of each mind, so on and so forth. But I think, in some way, that's also a nice statement of the case for MIT, in an intellectual sense. That, not everybody agrees with it by any stretch, but that the model of the mind is the cutting tool, or the drill, or the auger. Those of you, all of you, who are here as undergrads could probably feel maybe your mind as being expected to behave that way on a regular basis, honed finely and sharpened.

So, I sort of thought it was worth going through some of this. It is a difficult piece to read. It's written in this, sort of, 19th century English which can be hard to read, but it's actually a very rich piece, and he's got a very strong opinions, and some of them I think are still valuable.

I did exactly what he thought was a bad idea. Which was I did both a literary education and engineering education at the same time. And given that there's only 24 hours a day, it's very hard. I always my students it's not hard to do a double major, it's just twice the work. Which is sort of true, but inevitably there are compromises on either side. And the question is, what's the benefit versus what's lost, I think it probably depends on the individual and what you see.

I think in all this conversation, right, don't forget that the people who run this world are still more Harvard graduates than MIT graduates. OK. There is something about

that model, you go over to Harvard and you see Teddy Roosevelt, and Franklin Roosevelt, and John F Kennedy, and any number of US presidents who have been Harvard graduates. And any number of Harvard graduates who are in Congress, and the Senate, and the Supreme Court, at any given time, far out way, and even arguably at the top echelons of corporations, MIT graduates. And it is worth thinking about why that is, and why it hasn't been different in the last 150 years, that way.

So what we're reading is the argument of the people who founded MIT, and there's no question that in the scientific and technological world MIT graduates have been great leaders, and actually in other countries they are more likely to be found as presidents or top political leaders than they are in this country. There are many other countries where engineering is a much higher prestige profession, relatively speaking, than it is here. And there's reasons for that, historically. Even in France, for example, the polytechnic graduates really are the people who populate the upper echelons of the government. That may be changing now in the last 20 years. But it has not been changing dramatically. And so there's a lot of reasons for that. And it's a whole other conversation to have.

But it is interesting to think about what it really takes to train people to be leaders and how well are we doing at that? Or how well does Eliot's model do that? I think the general principle of it really does go back to the beginning. There has always been a fair amount of English history, management sort of stuff, languages, again.

Languages, were considered, frankly, they probably should still be considered, a core part of a technical education. Because we go around as MIT saying we're training global leaders and to do that and not have a language requirement for the undergraduates is a little bit missing the mark. That's my opinion. And I'm not someone who's good with languages at all. But many colleges have language requirements, and it probably would be, as someone pointed out, more Chinese than German today. That's fine. That's the way the world is going. But whatever people took would surely benefit them in the world.

But the actual school of humanities and social sciences was founded in 1949. We

just celebrated, well just, 10 years ago, we celebrated the 50th anniversary of the school. And the actual eight courses, I believe, dates from then. And that was a product, and we'll come across this, and we'll read the report that the so-called Lewis Commission wrote at the end of World War II, which really did a lot of introspection about what kind of place is MIT becoming. There's all this military research, there's all this big time research on campus. What do we really owe our students?

And you all know that you have eight required HASS courses. That's quite a bit larger than most comparable technical institutions like Caltech and RPI, Georgia Tech. It's usually lower. Certainly overseas at technical institutions it's close to zero. And so it is a much bigger component of it and arguably why MIT can consider itself now among the top ranks of the universities. If you asked people at MIT 20 years ago, who are our competitors? They'd say Caltech, Georgia Tech, RPI, The Royal Institute, ETH in Zurich and so on. Now, people will say Harvard, Yale, Stanford, Princeton. And that's really only in the last 20 years that I know as we compete for undergraduates, most students who say no to MIT as undergrads, where do they go?

AUDIENCE: [INAUDIBLE] Harvard?

DAVID KAISER: No, Stanford is the place where you lose the most people to. So that's a good measure of who you think you're competing against when you accept the student, and they say no, where are they going? Far fewer do we lose to Caltech or RPI or Georgia Tech. That's true--

AUDIENCE: Does that also have to do with the size of the school? Like Stanford is a larger school than Caltech.

DAVID KAISER: It may well. But Stanford is a very different place from Caltech. And so Caltech is a very small college, as you know. It's really, still is, in many ways a college. Other questions? Comments from the reading?

AUDIENCE: [INAUDIBLE] you mentioned before that [INAUDIBLE] college and universities. So

how did graduate education work for people in the 19th century here, or how did it work in Europe? Was there a lot of advanced degrees [? conferred?] in physics or what not?

DAVID KAISER: Well, up into the 1920's, certainly in the sciences, if you wanted to get a Ph.D, you went to Germany or to Europe in general, England, France as well. And so if you look at the MIT faculty in the sciences in the teens and '20s, most of them would probably have European educations at the graduate level. That was not just because of what programs were available but also because of the quality. It was really the German universities in physics that were the main thing.

That begin to change during the decades before the second World War. Not least when a lot of European professors came here. But PhDs in engineering, I mean you don't even see them-- MIT did not-- I know Vannevar Bush, who graduated with a Ph.D in 1916, I believe, that was MIT's fifth Ph.D in engineering. So a 20th century phenomena to be sure.

And, again, engineering was considered a useful art. A Ph.D was considered a high, scholarly calling. And there was a lot of ferment in and around I want to say 1890 to 1905 or so. University of Chicago was big in that. They hired-- it was in Worcester, Clark University used to have all these famous people. Robert Goddard was there for a while and so on. And now it's sort of a little university in a way. Why? Because the University of Chicago came in with a lot of money and hired away all their people around 1910, I believe. So it's very much a 20th century thing.

PROFESSOR: I was thinking about Warren Lewis who is the author of the report David referred to that established the humanities requirement at MIT. He was a chemical engineer. And he joined the MIT faculty around 1910, 1911 after doing his Ph.D in Germany. And so he's right at the borderline, I think. And he's very much responsible, in a way, for not just revolutionizing undergraduate education after World War II but also being involved in the establishment of doctoral programs at MIT.

After the arrival of Karl Compton which is 1930 that-- Compton is a physicist who came to MIT from Princeton and comes out of a background at which doctoral

education is important to him. And so he supports that. And then it really grows, I think, during his presidency and then beyond.

But Lewis is a really interesting person. To think that here's a chemical engineer who is talking so strongly about the need for humanities education at a technical university, basically, or a technical institute is very interesting. His granddaughter is a colleague of ours. And I think she's coming to give a talk about him. He's extremely interesting, he's one of these key people at MIT in the 20th century that had his hand on a lot of things.

DAVID KAISER: You would not find MIT faculty mostly having PhDs until probably also about 1920. Arthur Kennelly is either the first or one of the first electrical engineering professors here and really kind of founds the department. He was Bush's advisor. Where did he come from? He worked in Thomas Edison's lab. I don't believe he had a Ph.D. And Edison really started this model of industrial research around the 1890s. And that was what brought people back in.

PROFESSOR: Is that it begins to happen after World War II mainly because so much important research was going on here. And big laboratories were established after World War II or during and after World War II that would have enhanced graduate education. And as a result, when you're educating the best, you hire them. I think that's how it happened, especially in the School of Engineering which has had a fairly long track record of hiring its own. If you're producing the best, you try to hire the best. And so I would guess, it's a guess, I don't have the answer, but I would guess that it's right after World War II that you begin to see it.

DAVID KAISER: So I would give you a different answer. I would guess that it was earlier. Because, again, if you read all the stuff like in Elliott's piece about why the institution not only needs to be what it is, but it needs to be autonomous. I often think of it as a kind of sign of MIT's arrogance like nobody else in the world is good enough. So we have to hire our own students.

But you read this sort of stuff, and you see it's part of the culture in that when they're on the cutting edge of either a field or just generally of the types of teaching

that you're doing then you really, it's very hard to find people from elsewhere who are doing that.

PROFESSOR: So, you would say it's during the Compton years starting in the '30s or thereabouts? Or even before that?

DAVID KAISER: I would imagine it's before that with hiring instructors. Not sure about that.

PROFESSOR: That's interesting.

DAVID KAISER: Obviously, it's not so early on. But I bet as soon as they become the right age, it's something that gets done.

It can't be something that's done that often without some traditions behind it. A lot of universities won't do it at all. Although, here, I was talking to someone in Economics, they won't hire their own graduates on the faculty until they've gone away for a year or two, and then they will hire them back. So, they have a rule that you cannot come out of your Ph.D and join the faculty. But you go somewhere else for a little while and then you can come right back. And many of their faculty have PhDs from here.

PROFESSOR: Not a bad rule.

Not to my knowledge. I don't think there is a big difference. It's basically a play on the same word, technic but preceded by poly means many. Basically, it's perhaps a reference to a more diverse approach. I don't know. You're asking good questions. I don't have the answers.

DAVID KAISER: I think it's just what you said. I think polytechnic, especially at this time, has a little more European connotation. The French schools really are, they are called polytechnique. And they have a certain way of being that. West Point was modeled after much of, but probably not so all of, in that they're very connected in the political system. And there's a very sort of well understood hierarchy for the alumni to go through and run the big bureaucracies and the government.

And there are polytechnic schools in this country. There's California Polytechnic, there's Brooklyn Polytechnic. And I think it's really those are not-- there's no

meaningful distinction from them from MIT or Caltech. It's a kind of term, connotation.

PROFESSOR: The other thing that's relevant to that is that Rogers, Charles Eliot, William Ware in architecture all spent time in Europe, especially in France during the founding years of MIT, late '60s early '70s, looking at European universities and, to a degree, German technical institutes. And so they're influenced by these European organizational models, if you want to call it that. They don't copy them directly. But they surely are looking and trying to find niches where certain parts of the French educational system fit in to the MIT model and stuff like that. They're borrowing. They're definitely borrowing ideas as they should.

And so those influences are very much in evidence especially during the early years.

DAVID KAISER: It's worth mentioning a phrase that may come up which is technocrat. Has anybody ever heard that phrase?

PROFESSOR: Technocrat.

DAVID KAISER: You'll hear it used from time to time. And, again, technocracy is a sort of funny social movement from the '20s. It's not quite worth talking about. But people do talk about technocrats when they're technically trained people who are in high positions of bureaucracies of one kind or another and bring a sort of technical mentality to running a large organization.

And, again, in France, the technocratic tradition is a very old tradition where the leaders of the polytechnic go into the UN, they go into the various civil bureaucracies, and it's the big government institutions are very much run by people with technical backgrounds. It's just not a tradition in the US that has been nearly so much.

And so we'll come across it when we talk about the '60s like Robert McNamara who ran the Pentagon during the Vietnam War is not an MIT graduate, he's not an

engineer. But he was a very technical person, very mathematical. He was a sort of prototype technocrat. But most leaders of the Pentagon are not technical, most of them are political in background and have very different kinds of skills and approaches to the world.

Robert Seamans, who we'll talk about as well, who was an MIT graduate and kind of led the chief engineer on the Apollo program and Secretary of the Air Force and the first Secretary of the Energy was much more in a kind of technocratic role where he had this kind of background. And so you'll see some of it in the US setting but not that much. Whereas, again, the polytechniques and the English system doesn't really work that way either. They have their own civil service system and engineers are not particularly high up.

PROFESSOR: Seamans is one of these MIT trained engineers, comes from an old New England family as I understand it, but who really reached in the higher echelon. He wasn't a politician, but he ran a number of agencies and really was a person of considerable influence. He's only been dead, what? Three years, four years?

DAVID KAISER: One or two. Has anyone heard that name? Robert Seamans?

PROFESSOR: Robert Seamans, aero?

DAVID KAISER: We'll come across him.

PROFESSOR: I'm so sorry he's not still alive to come and visit this class because he was quite--

DAVID KAISER: He's an interesting story. You know we haven't also mentioned huge issue of social class between Harvard and MIT. And all of this stuff that we're reading has buried in it the sort of MIT attitude that Harvard is for elites, and the Harvard attitude that MIT is for vocational middle class workers. And that runs throughout all this history.

And Seamans came from this very old New England family, comes from a family on the North Shore. And he went to Harvard as an undergrad, in fact he was classmates with John F. Kennedy. And I think he maybe took one course, or he had a friend who was doing something at MIT, and he got really interested in MIT. And

he wanted to come here for graduate school. And he writes in his memoirs about how his parents said, no, no, no, fine boys from our background don't go to MIT, that's not what they do. Go, study science at Harvard. And he rebelled against that and really said, no I really want to go to MIT. And he did amazingly well here.

But when time came for him to advance in his career, he was certainly helped by the fact that he had this advanced social background when he went back to Washington. And, again, he was rubbing elbows with JFK and all the senior leadership during that period. And he was socially very well suited for it. So he was a little bit unusual as an engineer during that period.

PROFESSOR: About every 20 years, there's a discussion that pops up in the MIT community about why doesn't MIT have as many CEOs as Harvard or Princeton or-- and a lot of it centers around what David has just said is that if you look at the social backgrounds of CEO's, the majority of them come out of backgrounds like Seamans. They come out of well-to-do, socially placed families. And so there's this generational movement that you went to Harvard, and you're from an old family, and you have an interest in the company, you become the CEO at some point. I think there's a lot of truth to that.

And MIT, I think, has been more of a place that has attracted socially mobile students from middle class backgrounds, sometimes working class backgrounds, oftentimes, I think. And which is one of the great things about the place, I think, is that--

DAVID KAISER: The fraction of our students who are the first generation of their family to go to college, even today, is very high. A lot of children of immigrants--

PROFESSOR: I think there's a very old cultural influence involved in all of this in the sense that during the 19th century when we're talking about the founding of MIT, one of the tensions of that period in the academic world was between what groups we'll call Ancients versus Moderns. And the Moderns would be the type of school like MIT that was emphasizing science and engineering as opposed to the Ancients, which were the old classical colleges teaching Greek and Latin and all the classics and

literature and things like that.

There was a lot of tension there. And it also had class implications that you were educating people on the classics to be gentlemen and ladies and things like that. Whereas people coming to the MIT were people that were going to go out in the world and engineer that world or pursue science in that world. It was a much more utilitarian oriented disposition, I think, which is very American in many ways because early sociologists, I guess you could call them, people like Alexis de Tocqueville, who visited the United States in the 1830's and wrote a very famous treatise called *Democracy in America*, asks a lot of questions about what makes the United States what it is. Why is it different from Europe? That's one interesting questions he's asking.

One of the answers he gives is that these Americans are so utilitarian oriented. They are very oriented towards things that work, things that are put to work in society. Where as you don't see as much of that in Europe. That was one of his most important statements about the difference between Europe and the United States, is Americans like utility. They like things that work. They like to get out and tinker around with stuff.

He also talks about literacy in the United States being higher than it is in Europe. And that being a more literate nation meant that the United States was more apt to be inventive and pursue areas of engineering and science that others would be less involved with.

DAVID KAISER: It arguably is. Which I'm not so sure, German--

PROFESSOR: Maybe.

DAVID KAISER: I'm not so sure. Where it is also is very much in developing countries even in the Middle East and lots of places where MIT has had an influence actually setting up engineering schools. But I'll give you one example, a lot of wealthy American families, they send their brightest kid to Harvard and may become a lawyer or other place and become a lawyer. I used to spend a lot of time in Turkey. And I worked

with some people who were very wealthy and ran a lot of big international trading which is an old Turkish kind of profession. And these were the very few, very elite families in that country. And the people who were my age who were really the ones running and soon to inherit the business, they had all gone to American engineering schools and gotten American MBA's. That was their education.

And I was once at a conference, and I sat next to a guy who was a deputy oil minister from Iran, which I don't meet a lot of Iranian government officials in my work. And I was sort of like, this will be an interesting conversation with the two of us are going to talk about. And he was like, you're from MIT? I went to the Iranian Institute of Technology, it was all founded on MIT's principles. And he was incredibly pleased to meet someone from MIT. And sort of like a lot of the Iranian technocratic class, as it were, were trained as engineers.

And, again, it has a lot to do with when countries got on the steep part of the development curve. And if it was after World War II, engineering is generally a pretty high status thing in the field. If they're older countries, it's going to be less so and more political or financially oriented. That's a broad generalization, but it's probably not that--

PROFESSOR: It's interesting.

DAVID KAISER: I have one story that maybe we should end with which was, I went to Yale as an undergraduate, and I was a middle class kid. And I remember going to graduation-- has anybody here been to one of the MIT commencements, by the way? You'll all go in a couple years.

PROFESSOR: I hope you do.

DAVID KAISER: Hopefully, you'll all go. So when I graduated from Yale, it was a beautiful May day, and it had the feeling of sort of a garden party. Everybody was incredibly well dressed and sort of very polite and well behaved with the big hats on. And you had the sense that these families had been to Yale graduations many times in the past. And it was very sort of contained. And the clapping was sort of like this.

When you go as faculty or as students too to an MIT graduation, you march down Memorial Drive in all the regalia, and there's somebody in the front with the processional. And you don't really see any of the parents or any of the audience until you turn off of Memorial Drive into the Killian Court, right in the center there. And it has this feeling, you feel like you're at a rock show. I mean the parents are just over the top. And there's hundreds of them outside the gate because they only get two tickets per grad, but they bring like 15 people and cousins and aunts and uncles and grandparents and everything. And you really have the sense that it's like a huge celebration.

And, to me, that always represents that kind of different social standing where it's a really big deal for families when their kids graduate from MIT whether they're immigrants or not because-- but it sort of represents something. Sometimes that's a pressure that the students carry, which is not so easy. But it really represents something. And it's a big celebration. It's not nearly as much something that generations of Smiths have done for all these years, and it's been expected, and we're so proud of you, kind of thing. And you'll see when you graduate, it really feels that way. There's 10,000 people there. And they're just sort of like coming out of the woodwork and climbing up the trees and everything. And it's a very-- to me that's the kind of ultimate MIT moment where-- it's nice as a faculty member, you remember like what we were working for all these years and I'm sure students as well.

PROFESSOR: Yeah, it's a good time, you'll enjoy it. Alex will go up to get his diploma, or whoever, and you'll hear people shouting from the audience, that's my Alex. And then other students are going, ah Alex, way to go, blah, blah. It's all very exciting.

DAVID KAISER: And they read every single name of the 2,000 or so people who graduate, which itself is quite an accomplishment of logistics to make that work.

PROFESSOR: You'll have your hand shaken either by the President or the Provost. Isn't that they hand out every degree? So, it's pretty cool.

When I went to Ohio State, there were like, I don't know, 5,000 people on the

football stadium. They are all down on the field and the President gets up, and said, I hereby declare you Bachelor of Art. Boom. And that was done. And everybody goes, OK, let's get the hell out of here. It's very, very different.