Video 3: Keynote

[00:00:00]

David Kaiser Good afternoon. Thank you all for coming for this afternoon session. Thank you. My name is David Kaiser. I teach here at MIT. I teach the history of science and I also teach physics.

I'm the department head of MIT'S program in Science, Technology, and Society. And I'm really just delighted, very honored to be a part of this exciting symposium. I want to thank the organizers-- Caroline Jones, Stefan Helmrich, and David Mather-- for including me. And I think we're all in really for a great treat this evening.

So I was asked to set up our keynote, to introduce our principal speaker, Professor Bruno Latour. And when I agreed to this a year ago, I thought, sure, I'll introduce Bruno Latour. How hard could that be? Then I learned I had 15 minutes, and that's exactly enough rope with which to do damage. So I will try to say some, but no doubt all the things one could say about Professor Latour.

So we can start with the simple, the Wikipedia-esque. Professor Latour was for many years a professor at the Ecole de Mines in Paris. A few years ago, he moved to see Sciences Po. In fact, served for several years there as vice president for research. He's also had a number of longstanding, extended visiting appointments in many wonderful places.

Many of us first encountered Professor Latour's work through his writings. I'm showing here the English language editions. Nearly all of his books have appeared in multiple languages, including French and English, but well beyond-- German and many others. The first book you see their, Laboratory Life, was published along with sociologist of science Steve Woolgar in 1979. I just want to pause on that book for a moment.

I read that book cover to cover three different times as an undergraduate. And I think that already tells you about my squandered youth. But I read that cover to cover all the way through.

The first time was my very first year of college. I was all of 18 years old and so already knew what I had to know. And the book was self-evidently, preposterously false. I mean, this was just ludicrous. Who would assign such a ridiculous thing? It was not just wrong, but trivially so, my 18-year-old self convinced myself with no trouble.

I read it again about a year and a half later, and this changed my life. This was an awe-inspiring book. It was as if it was a page-turning novel I couldn't

put down. It wasn't just right, it was deep, it was profound, it was astonishing.

This is what we all should be doing. And then I made the mistake of reading it a third time. I should have stopped.

And the third time I read it, I found it interesting, I certainly found it correct. But I thought, don't we already know all this already? And so there, I think, tells us a great deal about the American undergraduates, the rhythms of undergraduate education. And it's still a book that I delight in returning to to share with my students to this day.

And of course, Professor Latour began there. He didn't stop there. It was followed in very rapid order by a series of books, each of which is really iconic, and are still in our syllabi to this day. We have our students read and reread them many times, and they're well known, I'm sure, to many, many of you to this day.

That first row covers, we'll call it the '80s. It goes from a Laboratory Like in 1979 through Aramis, published first in 1992, so just over a decade. Five really quite astonishingly provocative books that have helped shape our field.

Of course, he wasn't done then. The next books were written over the next decade, so now we'll call this roughly speaking the '90s. And I will accelerate, because I've more to get through.

And then just in the past decade since 2005, when Professor Latour published Reassembling the Social, through his most recent book published just last year with Harvard University Press, An Inquiry into Modes of Existence. And again, we learned a great deal in the book, Laboratory Life, about the sort of micro-dynamics of specialties, of specializations, of whom scholars seek to speak with to establish matters of fact.

So I want to book end the rhythms, the periods of these books with some notable honors. So in 1992, Professor Latour received the JD Bernal prize from the Society for Social Studies of Science, the highest honor in the field of social studies or science, for books that, as I say, had already helped to radically recast the field. At the end of the second row, skipping many honors in the interest of time, Professor Latour was named to the Spinoza chair in philosophy at the University of Amsterdam. That's a very distinguished visiting appointment.

So you can see, he's moved from one, we might say, core set into larger concentric circles. And then just last year, he was honored with the Holberg Prize, often called the Nobel Prize equivalent for the humanities, arts, and social sciences. Quite an expansion of the circle yet again.

Around that time, he was named France's most influential living intellectual. And again, I want to pause, if I may. One of my favorite chapters in the book Laboratory Life that I mentioned before, the chapter is called "The Micro-Processing of Facts." And what Latour and Woolgar do with great skill is show the progressive pruning, is the removal of caveats of sort of words that would eventually be removed for a kind of straightforward textbook declarative statement, all the caveats or the cautions that might appear in early utterances among, say, colleagues in the hallway. And so I was indeed curious by the presence of these words here, which might one day and be superfluous. But nonetheless, most influential living intellectual.

[00:05:26] Let's come back to that book which, again, I've mentioned, Laboratory Life. This is from the middle section, the photograph file. This is, as you can see, is labeled office desk at the Salk Institute where the field work was conducted.

And again, I've often been skeptical. I've been curious about this image. Now that I have you here, I can ask.

This can't be simply the ethnographic given. I always feared this image was a bit cooked up. It looked actually a little too neat.

This is what a proper scientist's office actually looks like. the point remains the same, but I thought the version in '79 was maybe just a little bit sort of airbrushed. Nonetheless, he was drawing our attention quite immediately to the flow not just of people and ideas, but very particularly to what we would come to call inscriptions.

In fact, Latour and Woolgar mapped out there ethnographic sites early on in that book to show the flow of the objects or the entities you can see marked here, the actants. But what was clearly of most concern to the people they were describing was up here, the articles. One more kind of output, the ultimate type of inscription that the scientists hoped would then go flourish out in the wider field.

And it was following those inscriptions, in fact, that Latour became more and more invested in his later books, the books that would follow shortly after. His book on Pasteur and the war of the microbes, translated as Pasteurization of I and also in is the textbook in the mid '80s called Science in Action. The conversation was not only the flow of inscriptions and material within one site, but beyond. And in fact, it was the circulation-- the goings and comings back-- that commanded the attention next.

And this is when Latour began to talk about things like immutable mobiles, a phrase, again, which doesn't quite trip off the tongue. It's much clearer in French. But this notion of these inscriptions, these two dimensional flat things which, in some sense, could be fixed-- the print or the inscription

would have the benefit of being immutable, at least so the argument had been. Certainly mobile-- very easy to get these things to move within and beyond the laboratory, unlike, say, the rats from which biological samples would ultimately be taken and interpreted.

The inscriptions-- the flat inscriptions-- could be made to move. And in fact, they could capture scale in a remarkably efficient way. If one shows a clever representational scheme, one could literally have dozens of orders of magnitude crunched on one simple inscription, from quarks to the cosmos. And so this helped to energize the next series of studies, moving towards the importance of representations and their movement.

And then these notions began then to build to an argument for Professor Latour, which he articulated most first and most forcefully in his essay, We Have Never Been Modern, where he argued that by following the work it takes to make these inscriptions and to make them stick and flow, that maybe this inheritance-- from at least as strong Western tradition dating at least back to the Enlightenment-- an inheritance of a series of binaries, of dichotomies might, in fact, really be much more aspirational than real.

So it might be that what seems at first to be a very clear or necessary or solid and fixed division between nature and society, between science and politics, between things of various sorts; and the perceiving, thinking people who manipulate them and try to make sense of them, that maybe that division is not, in fact, a feature of the world as given. That is not where we start. Those binaries, to the extent they exist, are the outcomes, the products of work.

That's the endpoint, not where we begin. What if the division between them is always in motion and in the act of being made, not a given from whence we start? And if so, then that must have all kinds of implications for our notions of agency, how we account for change.

And again, readers or fans of that really textbook Science in Action will remember very fondly, I think, these two paired heads, Janus faces. So for example, if society is not simply a given that is just there in the world, then it's awfully difficult to ascribe causal powers to something we've called society to account for some other change. If we might just as well have flipped that on its head and accounted for the coalescence of something we could point to and call a stable society.

What if that's the outcome of work, not the driver of the action, and so on? And many, many similar sort of dichotomies that Latour argued are part of this modern program that has never actually been the world in which we live. It was an illusion with longstanding power.

[00:10:02] So we come back then to these Janus faces. You'll notice classically-- and I hope the art historians in the room will back me up-- the bearded figure is always on the left. And so, I've decided to follow-- who am I to buck that trend? So we come now to the Janus faces of Professor Latour.

And about a decade ago roughly, I think we can see a pivot in this amazing outpouring of work of these 15, 16, 17 books and multitude of essays. A pivot starts to emerge, at least as I read the work, around 2004 between matters of fact-- which had been, in some sense, the square, the central concern of much of that earlier work-- and a new, complimentary notion which he begins to articulate as matters of concern. One place to note this pivot-- I actually just reread this essay again this morning-- was a very powerful essay entitled, "Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern," published in Critical Inquiry in 2010.

It's certainly the impulse, the energizing force between his collaboration with Peter Weibel on making things public. And it is indeed what drives the most recent book, On Inquiry into Modes of Existence. So in the opening pages of that most recent book, in the introduction, we encounter passages like this one.

"If geologists themselves, rather stolid and serious types, see humanity as a force of the same amplitude, as volcanoes or even of plate tectonics, one thing is now certain-- we have no hope whatsoever-- no hope in the future than we had in the past-- of seeing a definitive distinction between science and politics." Now what's interesting there is that appears on page nine, not page 509. That is the beginning of the latest inquiry.

That's no longer the place one ends-- perhaps smugly or proudly-- as the endpoint of critique. That is simply where we must begin, and that means we can't end there. There are too many challenges, as Professor Latour has been passionately arguing and thinking about now for quite some time.

Too many challenges that demand a different apprehension of forms of knowledge production, of forms of meaningful democratic action, that simply saying that facts are made, that science and politics are not inherently distinct beasts, that's not enough. That's the beginning and not the end. And so again, I come back to that essay from 10 years ago where he is introducing-- or one of the places he introduces this notion-- of matters of concern.

And we find this again, this, I think, very fascinating passage. And he writes, "The critic is not the one who debunks, but the one who assembles. The critic is not the one who lifts the rugs from under the feet of the naive believers, but the one who offers the participants arenas in which to gather. The critic

is not the one who alternates haphazardly between anti-fetishism and positivism like the drunk iconoclast drawn by Goya, but the one for whom if something is constructed, then it means it is fragile, and thus in great need of care and caution, much like, for example, the Earth and our place within it."

So he has written in this most recent book, Inquiry into Modes of Existence, of the need for certain types of scholars-- and he thinks those in science studies might be especially good at this role-- a certain type of a scholar to be diplomats, that we must be able to foster discussions among many types of knowers to rethink the bases of knowledge production and of action more broadly. And so with that in mind, we are very lucky to have following Professor Latour's discussion comments by MIT's Professor Tomaso Poggio, a neuroscientist here. I will introduce Professor Poggio before he speaks. But first, I hope you'll join me in welcoming Professor Latour for his keynote address.

[00:13:51] [APPLAUSE]

Bruno Latour: Thank you very much, David. I understood that it's better to read the book only two times, not three times. But of course you have to buy them three times, which is a very good question. Can I have the first slide please? So I've been asked to talk about the philosophy of common sense, so to speak, but in a very slightly different sense, that is *sensus communis* which is the demand that Caroline gave me. And I will try to go through some of the program, what the first one is, how do we make ourselves actually sensitive? And sensitive to one specific character, which is the one I choose, and which is the one which is occupying me a lot right now, namely Gaia. Gaia is a strange character.

It's a sort of figure which is a very mixed figure, mixture of science, lots of religion, very strange religion in it, lots of law, lots of politics. And which is well illustrated, I'm not going to talk so much about it, but well illustrated by what I think was a very moving and beautiful image of diplomats around the negotiation in Warsaw in December of 2013. The lady, the second lady seated on the left is Mrs. Figueres who has the terrible responsibility of running for Ban Ki-Moon the negotiation.

And the man on the left standing is the chief negotiator, and they were very busy those two last days, as you can imagine, and they are very busy all those, all this year, the next meeting being in Paris which is an important sort of framework for my interest in the question. But it's a very moving image where they're all concentrated on rendering not only themselves, but the rest of the public, the rest of the planet, sensitive to a phenomenon.

And I choose this maybe too big example to try to relate to some other things which is the theme of a conference. And of course it's not only

diplomats who do that, but also I will have the benefit of being in the march with 400,000 other people on Sunday. And it was very moving to see the numbers of things with which people try either scientifically or in a sort of more joyful way with different types of concerns to make themselves sensitive to the issue of the day, which is the question of, there is no planet B.

So there is a range of things with which we try to render ourselves sensitive to. And I will use the aesthetic for that, aesthetic in this original sense of making oneself sensitive to. And I will make no distinction, because that's the goal of our symposium, between making oneself sensitive for scientific instrument, and making oneself sensitive through lots of our formats associated more or less with the arts. I'm not going to talk about politics in this talk at all, but of course it refers.

[00:17:10] Now, the problem is that there is a definition, which makes it difficult, difficult for us to be sensitive, to make ourselves sensitive, which is associated with the notion of matter-of-fact David mentioned before. Not the objectivity of science, but a very strange puzzling definition of matters of fact which establish a relation between a subject and object which is extremely bizarre, and that historian of science, historian of art, historian of psychology begin to unravel into the European and Western tradition.

And that this idea that there is a subject watching an object, which is a very bizarre thing, if you think of it. Because it's never the situation except in a laboratory situation, a highly artificial situation where you find ourselves faced with a subject, the point of view, the POV there, and the still life. My argument is that lots of our philosophy comes from still life. It's a sort of disease of the Dutch, so to speak, where as you know Descartes and Locke spend a lot of time in Holland, and they saw too many still lifes.

So they had this idea that actually it makes sense to stop an object, and of course an object as Professor Conway reminds us a minute ago is not stopped. An object is a trajectory. He mentioned the banana, he mentioned lots of things, lots of color red. It's actually a very moving event which has a trajectory. So first to have, to even imagine to meet an object you have to interrupt it in the middle of its trajectory.

And then you have to create this very strange idea of a plane in between, which is of course not so visible in science, but very visible in art, especially of course in still life. But when you need to add something, someone with a sort of function which a very impolitely Samuel Garcia, an architect who worked for me and made in the face of Le Corbusier. You need a figure that occupies this intermediary situation which is never really conceptualized of staging the situation where an object and a subject could be together.

But subject and object are not native entity into the world. They are not born there. No one is born a subject, watching an object. It's a very bizarre situation, as William James assured, and many psychologists, Gibson and

others, and which is criticized of course by lots of neuroscience that you know much better than me. So you need actually to imagine, and that's what anthropology of vision should also do, which is, what it is this function, this strange position where you have an active subject, of course it's not a real subject, it's a conceptual un-interrogated figure which is staging with the hand. That's why the hand is important there.

On the other side is the abstract intermediary screen. And making possible for an object to be there, visible for a subject. But it's a very artificial position for a subject, for an object. And it's also as, it has been shown from Panofsky on what many people, a completely abstract definition of what the subject is. Remember, Panofsky, the subject is actually one eye, which is very, not very common. And it's an eye which is not, which doesn't have all the equipment that Professor Poggio is going to talk about later. So it's a very isolated, very abstract definition of what it is to be a subject.

The critique of the subject-object has been made many times, but I think what is interesting is to see that the whole setup is very odd, the whole setup of imagining this connection between a subject and an object with a screen in the middle and this sort of strange mediating function, organizing the visibility of a subject, of an object for a subject, interrupted in their course, the subject and the object, is completely implausible. None of us is like that. None of us is actually watching face to face, except in a very, very artificial situation in which precisely you are looking for other things than the experience of being and seeing.

So what would be better is to imagine how you circulate yourself sort of naturally and not face-to-face with an object. And of course, art historians as well as historians of science of trying to interrogate this strange middle figure, mounting, so to speak, and staging the scenography of object and subject, but it's not the way we live. That we are in that world, in spite of, that is one of the things which is interesting me, as David Kaiser reminds us of the anthropology of the modern, the anthropology.

[00:21:59] It's interesting because it's so unlikely that anyone would actually be a subject in front of an object, and yet this is the origin of lots of philosophy and cognitive scientists. And the neuroscientists had enormous work to get out of this idea which comes from still life, which is quite odd. But most of our philosophy, our epistemology, our definition of science is coming from painting, not from an experience of vision, of the experience of actually seeing the world. All of that is in one way, William James of course. This is just to remind you of this important point.

So how do we make ourselves sensible to, not to matter of fact, but to matters of concern. And matters of concern is still material. We are still talking about the objectivity of the world. But it's objectivities of the world which are interested, and it's not so much of a factuality as the concern which interests me. I'm going to show two films, one for the situation in time, and one of a situation in space, trying to make ourselves sensitive to

what it is in this new situation where this character which was always given to us, that is the background, it was called the Earth, the backstage so to speak, becomes active.

One of them is a dancer. I called it The Angel of Geostory, by allusion to Benjamin's famous Angel of History. But now we are not in history, we are geostory. And you are going to see it very short. The Stephanie Ganachaud is making a movement I asked her to do. And it's a split screen of the same scene on two sides, but she's moving, and you will see. This is the Movement of the Angel of Geostory. She flees, she flees, she turns, and then she sees something else. And what she sees, again, after having fled so long, is not terribly nice to look at, apparently. She sees something else and then she's frightened again, and she begins to move backward.

See, that's a way for dance to render ourselves sensitive to a time situation in which we are now, that is, we had fled the horror of the past. And then while we were away, we turned around and we see something else which is even more frightening, which is the figure. We have many names for it, but let's call it Gaia. So this is the situation in space. Now, how to render, in time.

But how to render us sensitive to space, we will see that a lot tomorrow afternoon, I think, with Tomás Saraceno. But I was fortunate enough to be able to be there in Bicocca in Milano in 2013, and this is what it is to be when an artist sees the prime of situation of making us sensitive to a new situation. What it is to be on an Earth which is actually moving, where even standing up is impossible.

And Tomás Saraceno had invented this amazingly beautiful, and terribly expensive also, dangerous, he's not a cheap artist, as you all know. I know because I am trying to bring him to Toulouse and he asked us to do all sort of strange things like a balloon that we have inflated in the middle of, I mean, it's, anyway. We will discuss that tomorrow. And here you see a very beautiful case where, when people are sort of glues in this space up there, they cannot move and stand, they have to crawl like they were two years old, or even one year old, and just begin to re-imagine what it is to be in space without having the benefit of being standing on a stable place.

[00:26:08] And that's of course a very powerful way of rendering the difficulty of feeling and especially to make us realize again how rare and how unlikely it is to face an object, and that to take this situation as the sort of epitome of subject-object relation. Neither in time nor in space this is now possible. We are in a very, very different time space. And this is where the sensitivity, coming simultaneously from science, and we'll discuss that tomorrow, Saturday, with Tomás, who is very influenced by science, is so important. All sort of sources of making one's self sensitive to things which interests me.

So what I want to do in the remainder of this presentation is to try to compare medium, because I think that's what is interesting in the

comparison which Caroline has organized here between register, so to speak. How do we compare, how do we make basically the same situation, that is, how do we cope with a new time space in a different medium, completely different medium? Some come from science, others come from other disciplines of the art. And even in the arts, it's coming from a different medium. So the two aesthetics, again, is, remember the etymological sense of an aesthetic, and how do we render ourselves sensitive to things that then come to you? They can come to you, but if you do not render yourself sensitive to it, you just don't listen to them.

So what I did, and I want to review some of this here with you, is an experiment last year in Toulouse which was called the, which aesthetics for the sciences of Gaia. Assembling scientists and artists, a bit like here, this is why I thought it would be a good example. But trying to ask different people to tell in their medium why is it possible or difficult to register this change of space and time? To make, why is it so difficult to make yourself sensitive to this new situation? Because we don't have experience. The background had always been there. We never had to really handle something like a change in the background. We have to handle many other things, many psychological situations, many historical situations, many political passions, many religious passions. But passions of the Earth that we didn't have to handle except in a very few rare set of catastrophes.

I'm not going to review all of the people, just a few. I'm going to review Squarzoni, who is a very, very, very interesting graphic novelist. Adam Lowe, who is an artist. Oliver Morton, who is a writer. He's the head of the Economist. Tomás Saraceno, who is here. And Szerszynski, who is a sociologist of the anthropocene. And I'm not going through all of them. Just a few examples.

First, a puppeteer. He couldn't come to the meeting. He went through film. Puppeteers are very interesting because of course their relation with this puppet has nothing to do with the subject-object connection. They are supposed to be in control, and they always say, no, no, no, no, I mean, a good puppeteer is made to act by the puppet. And the puppet, even though it's the extreme case of control, it's also the extreme case of being actually carried somewhere else, or modified, or mobilized, or moved, moved by the thing you move, which is of course the interesting relation, the most interesting relation we have with the world.

Now, the reason why he was there is because he was the one who invented, or helped us to invent with the director of the play, some of you have seen it, it was in New York, and we're very proud of seeing that in a very chic place. I understand The Kitchen in New York the last three days, called Gaia Global Circus, of which I am one of the indirect authors. And what we were trying to do, precisely to render ourselves sensitive to this change of time and space, was to modify the décor, I mean the stage, so that you could actually feel, this is the little canopy up there which was suspended by

helium balloons, that they were moving around in a way which made the possibility of a show, of an active, active of a show visible.

[00:30:42] This is, it might be in French, but I'm sorry to have used this dead language, but it's still useful for some time. And this is just a few so that you see, you get an idea of what the setup was, where the canopy is sometimes on the top just like here, but imagine that this is moving. You will be very disturbed. The actors were very disturbed also by this moving canopy. But that's part of the story, is to see the canopy, I don't know if you call it canopia, I'm sorry, there is a translator there also who is making gestures.

So this was not a joke. I told them there would be one of those guys there. So it is, you see one of the problems is to make, to render yourself sensitive to a situation like that, you have to change the whole set. And of course theater is a mirror for that. Which the canopy are changing its position constantly and moving around, and being itself a model of the Earth so that what it is, a model of the model, so to speak.

And we work with lots of scientists, physicists, to try to make this, of course not in any realistic way, but in sort of a contaminated way a resonance with the simplification of model that scientists themselves do when they do climatology. And we have of course a relation with the model which is very much like the puppeteers. So if you say to a modeler, well you made it up, entirely constructed so it doesn't do anything, they would think you are completely silly. And of course a puppeteer would do the same, would think the same.

So it is the sort of thing that we try to establish a connection between art and science on the stage which interests us in this, called Gaia Global Circus. And of course what was very interesting was to have simultaneously, like Caroline has here, a physicist presenting the problem of making the model, this time a real model, of the ocean. And the question of a coloring, which is a crucial element we discussed, and we have discussed before.

And where you can, the whole question again of making a model of the Earth, and assembling the data, and making yourself sensitive to the transformation and the history of the, in this case, of the salinity of the ocean is not deeply different from the question of the first aesthetic, the one of the artist. Because the artists are not the subjective guys, and on the other side the objective guy as we saw in the first session this afternoon. They are both, all of our skills are trying to understand what it is that is coming to them because of a change of instrument that we have invented. Some instruments are staged. Other instruments are a model, and full scale.

But the question is, every transformation you make in your sensitive instrument captures other features at work. So in that sense, the distinction between art and science is ridiculous. It's an inheritance of a subjective history, and the idea of aesthetic as a subjective quality. But it's not actually what these guys were trying to do in this enterprise.

[00:34:04] And the connection between the two was even more interesting when it was the turn of Adam Lowe. Adam Lowe is the head of Factum Arte in Madrid. He is a great artist. And he had tried something which is typically of interest for geographers as well as for artists, which is a new way of projecting the Earth itself. That's a typical, typically what it is to make yourself sensitive to things. But it, we have seen the projection, the classical projection of the Earth many, many, many times. And is there another way to do it? And there are many, many, many ways of course.

But Adam had invented, and his team, a very interesting way. I don't know. I hope you begin to recognize. But if you don't, it's good too. Because it means you become attentive to new features of the Earth where you minimize the sea, or at least you shift the sea quite liberally on the side, and you respect the exact proportion of the surfaces, which is always difficult, as you know, when you project a globe on a plane. But in addition, you actually increase and very, very sensibly increase the depth so that you are now sensitive to the features of the depth, including in the seas, which is of course well-known.

I mean, this is, there is no new data here. What is new is the way it's re-represented in a deformed way to make ourselves sensitive to the new features of the Earth. And here's a little way to show, because that's the idea of Adam is to have it actually in Venice, to have the model in Venice for reasons which I have no time to explain, except Venice will be flooded, like here. No, like, well like lots of other places which will be flooded. And to try to flood the model at the different depths so that you begin this time to get sensitive to these pretty important matters of concern, which is what will happen to little things like London, New York, Bangladesh, and so on.

And what he did was to, this is the thing that, which is itself a simulation of the scale model at the size of a football, how do you call that, football? Field. A football field, thank you. Where the spikes is the artificial representation of the pixels. So it's actually bored into a polystyrene before it will be done in another material. Adam was like Tomás, a pretty expensive artist, wanted everything in marble. But I think we decided that marble might be a bit too expensive.

So here you are traveling toward the Arctic, what you see there. You're also in the Venice, in the Fondazione Cini, Island of St. Giorgio, where the plan is to have this amazing model. We built a small model in Toulouse in two weeks actually. It will be here today, actually, arriving. Not of that size, of course. And you see this is an interesting case where art and science are mixed, this time not at all like a subjective rendition of anything which is objectively factual, but as a new way of getting deeper into features of the world that are there only if you manage to have the good visualizing this positive.

So when you begin to change the representation scale, you immediately render yourself sensitive to new phenomenon. So this is the model which is

now being shipped to Toulouse, where we again try to do the same thing again with Tomás Saraceno and others to try to multiply the register with which we absorb the very difficult news that you show in the Angel of Geostory. How do you absorb the coming to you of the world of, let's call it by its name, horror, after having fled from this other world of horror. And of course the solution which makes a lot of sense is to be insensitive to it, which is what most of the people do. Not thinking about it is probably the best solution. But it's not the great solution for civilization. So at some point you have to become sensitive to what is coming to you.

[00:38:46] By the way, I have not the equipment for that. Neither the scientists. They have, they scream everywhere, look, look, look, look, and no one pays attention except the ones who are marching in New York. So it's a very different form of register. How do we make ourselves sensitive to the phenomenon? This is why I'm passing through these different cases, because I think they are illustrating one of the problems. And what I want to spend some time on is another medium which is not always taken seriously enough except in course in France and Belgium where we have Tintin. But in this country, you have lots of others, but you are not as literate in bédé, you don't read like me bédé every day at night. So you, it's not the prayer of the day, like we do in Europe where we are more civilized as far as graphic novel is concerned.

Now, I am glad to see that Squarzoni, Philippe Squarzoni is the best book on climate change. I mean, of all the mediums it's absolutely amazing. It's now translated in English, but the few slides I'm going to show are still the French one. And it's an amazing experiment in trying to see, why is it so impossibly difficult to talk about it? And that's a topic of a novel, of a graphic novel. Bédé, you don't say bédé in English, right? Graphic novel.

And it is, so the experiment is very, it's a very moving attempt by someone who asks himself a question why no one understands what I'm going to talk about, which is the question of change? Why is it so invisible? Why is it so boring? Why is it so impossible to show in the medium that I'm choosing to show it? So it's a very powerful and very moving experiment in exploring the limits of a medium. And of course it's very difficult because, so you see he invented a whole vocabulary. Before he did sort of graphic novels about politics, mainly, which is itself a hard topic. But it's slightly easier, especially in France. I mean, it's not that difficult to interest people to politics. But to this subject, it's much more difficult.

So he invents, as we see, a whole vocabulary using images of press images, modifying them. And then, which is very bizarre for a graphic novel because it's the least, how do you say, sexy way of telling a story, showing in the bédé itself the difficulty of talking about it. So there is a long discussion with his wife here which is making fun of its impossibility. And here actually is a very interesting discussion about the shape of the planet, the blue planet as you might know. The blue planet is never, the only image of a blue planet, there's only one image of a blue planet where you see the whole Earth. In

all of the other, it's of course quite normally as a crescent, like the moon. But, so that's what this discussion is about.

But what is interesting is that it tries to show in the medium, using the difficulty of the medium, the limit and the difficulty of explaining those questions to the others so that a large part of, it's a thick graphic novel, is about talking heads. I mean, there are lots of television series which are boring where you have talking heads, but I've never seen a graphic novel of talking heads. I mean, this is very daring. There is nothing less bédé than that. And yet it's absolutely fascinating because you see all, this is two famous French climatologists who are members of the IPCC, the French IPCC, which are Le Treut and Jouzel, who are very famous scientists, making interviews, giving interviews to Squarzoni where he tries to make them talk on this impossible medium that is the graphic novel.

[00:42:50] And spending some time, which is quite interesting too, on his own imagination. Why is it that he changes his mind, is sort of imaginary, and we share with, he's much younger than me, but his first film was also, this is a great thing, we have the same first film. That is of course that you see there on the left, Peter Pan. I saw that when I was five. And he saw it when he was young. So he's trying to make the, to take, I think most seriously, I mean, there a few novels who do it, but I think it's the only graphic novel.

What does it change in the very notion of imagination to be an imagination about the Earth which is itself moving its position. To be on an Earth which is itself being active. Not being able to see far in time and space in the traditional sense which was pre-anthropocene, so to speak. And it's a very moving exploration of, how could I say that, the nuance of different imagination which should be mobilized to get into this question of ecology, and which are not by political ecology, or very rarely so except of course in the demonstration on Sunday. But usually those questions are surrounded by sort of well-meaning and self-righteousness, and they are not the occasion of getting another way of feeling the situation. And that's why it's so interesting to compare those different mediums.

And I'm not going to go through all of those, because the time is short. But it was interesting to see then in this sort of series, and I'm not going to talk about Tomás' contribution, because he is going to talk tomorrow afternoon. It was very interesting to have a writer, a scientific writer, the most difficult job of all. Oliver Morton is a historian of science who has become one of the heads of the *Economist*, and has written two absolutely splendid books on the, one on Mars and the other one on the Earth as a sort of Lovelockian view, a sort of Gaia-esque view of the Earth.

But strictly, strictly with quotations from the scientific point of view, except the scientific point of view is actually taken as the difficulty of writing well about this question. That is animating the vocabulary all the way from beginning to end of the book about plants. I mean, not an easy topic either.

And here, Oliver, and once I've finished to mount the film, I will put it on the web because I think the whole series is extremely interesting.

Oliver is here describing, how did he write the six first paragraphs of his book about photosynthesis? I mean, these are the questions which are completely un-worked, usually. How do you write about science? How do you make the difficulty of, how do you accept the difficulty of writing about science in a way which is simultaneously making yourself sensitive to it if you are not a specialist of chlorophyll, and being exactly as accurate as the recent discovery on chlorophyll, which is the normal question that scientific writers have.

But it is also a medium. It is also a medium which has its own register, has its own difficulty, just like graphic novels, just like models, just like cinema, etc. There are also musicians and so on in the thing, but I am not going to that because it will be too long. Just to show you that there is also a civic dimension here, this is the mayor of Toulouse who is giving us the medal. And here you might recognize the third member from the right, who is Clive Hamilton, a specialist of the climate situation, and not a very optimistic guy, I have to say. I also have to say, which is maybe sad for the politics of science, but the mayor lost the election after our demonstration. So the fact of being deeply interested in science and art doesn't mean necessarily to assure votes. I'm saying that in case the provost here believes that it's going to be [UNINTELLIGIBLE 47:17 on the video].

[00:47:21] OK, I will finish on another, on several other, making, how do you make yourself sensitive, which are associated with this argument that's slightly different. One of them is reenactment. I'm extremely interested in reenactment. And the one I'm most proud of, which is directly related to the discussion we had before, is the reenactment of the Bergson-Einstein debate, which had, which was of in of course, Peter Gallison reminds me of the exact date, 1922 in Paris, right? And that was reenacted in Paris in another version by a very interesting philosopher of Einstein, who redid the part that Einstein should have had. So it was a reenactment with a slight shift.

If you remember, Bergson was considered as a little out-of-touch with physics by Einstein, who dismissed his position pretty condescendingly, and saying, well, this is an idea of psychologists, it's not a cosmological question. I'm talking about real physics. And the paragraph we have of Einstein is about six lines. Not enough to make a whole reenactment. And Bergson wrote a whole book, as you know, about it. But afterward, l'esprit de l'escalier as we say in French. So what we did was several years later to restage the debate, but in a more, how should I say, equal way where Bergson had time to explain to Einstein, which was Einstein is played here by the head of the school, now the museum of, the Pompidou Museum. And he is interviewing the author on the right, who is playing Bergson. It's on my website, in case you are interested.

And what they are doing is that [UNINTELLIGIBLE redoing?] reinvented a position where Bergson could articulate that it was also a cosmological, not a psychological definition of time. But an alternative cosmology, so to speak, which is of course directly related to the first argument I made about matters of fact. Philosophers are not there to dig into the psychology, we are there to talk about the cosmos. And the cosmos have many dimensions, not just four. To have four dimensions is a pretty reduction of the numbers of dimensions in which we live. No one of us lives in three dimensions nor four dimensions, we live in infinite numbers of dimensions.

We make with artificial situations where we limit the numbers of dimensions, but that requires work. It requires a laboratory setup, writing, inscription, it requires a whole staging and scenography. So this is why it is interesting to work with a reenactment artist, because you see the work which has to be done. You know, let's reduce the number of dimensions to add psychology to a world of four dimensions is really of no interest. But to show how you can reduce the numbers of infinite dimensions to a few, that's really interesting.

And you begin to do that when you work with artists, not because the artists are going to talk about themselves. I mean, who is interested in the artist themselves? But interested in what the world, what we make of the world, which is also the same world in which the scientists have their own instruments. And I think that's the lesson of many of the artists, like Adam Lowe or Tomás Saraceno. So reenactment is very powerful.

Another one which might be, it seems to you a bit too pedagogical, but we are thrown in an academic situation where you have students. So reenactment is also a very powerful way of making the student understand things. And here, this is a silent movie about a reenactment where we ask the students, 300 students of Sciences Po to redo the failed Copenhagen meeting of 2009. So you will see, and I hope you can capture, just because of the way the film is made, some of the situation of tension. Here you are going to see the Indian negotiation team being worried about the, we are in the third day of negotiations.

They are representing the cup 19, the one which was, sorry, the cup 17. And it's 1834, the third day. And the big meeting has broken down, and the simulators, if I can say that, representing India are gathering together to try to find another position to start the negotiation again. And then they will have a night, a whole night of negotiation. You really have, this is India's position. It doesn't matter exactly what is said. But what is interesting, I think you can see the tension. Those guys are playing the role of the real Indian negotiator.

[00:52:15] And what happened is that during the day, they realized that they were not just playing a role, that this was a situation in which the real Indian situation was. Because when you do this simulation of climate change, what you do as a model, or what you do in real, it's still a model, and it's still real. So they

were just completely moved and tense by the situation in which they are trying to find out a situation, and realizing that if India accepted what the others, the rich country was trying to push on them, they would have to stop their development, which is exactly the situation, as you know, which was discussed yesterday in the United Nations.

So we always have to think about that when we talk about reenactment, is also how do you make the student reenact the situation? Of course it's more difficult to do that with Bergson and Einstein, but here it's the very, very important features which makes students realize for themselves what it is to be in the situation where you have to take the world, the planet climate on your shoulder, so to speak.

And I will finish, yeah, a little moment of publicity, because we are after all in an academic institution. We are organizing in May a counter-summit, modestly, where we try to do better than the United Nations summit. Madam Figueres is actually highly interested, having a situation where the constraints of the United Nations will be lifted. So if you have students interested in climate, students interested in reconstructing models and finding alternative way of negotiating, we'd love to have them in Paris the last week of May, 2015, six months before the real, I was going to say the real catastrophe, the real negotiation, the real negotiation in Paris, which hopefully succeeds.

But we are very interested. And that's the slogan of our initiative [on slide: "Paris Climat 2015, Make it work"]. So I will close on another case, because this is the convergence of natural science, art, and politics in the two meanings of aesthetics on a case which I found, which for me and Joseph Connors who is here will not certainly say the opposite, which has been very, very important for art historians, historians of science, digital techniques, which is the transformation by Adam Lowe, again, of a Paris Veronese painting of the *Nozze di Cana*.

So I think the miracolo here, the *Miracolo di Cana*, I'm sure the *Miracolo di Cana* will go straight to the heart of Tomaso, will, was an extraordinary event where Adam and his team, on my suggestion I have to say because I'm very proud of it, I need to have this little bit in me, was in the Louvre with this ridiculously big Veronese painting, *Nozze di Cana*. Not at first a very great painting. I mean, a very large painting, but not so, so extraordinary except why? Well, because it's in the Joconde room, so you have about a million Japanese watching, turning their back to the painting and looking at the Joconde, which is just there. And it's framed, which is ridiculous. And there are two doors on the other side.

It had been taken by Napoleon, Napoleon Bonaparte when he destroyed Venice took, actually stripped the canvas and brought it to the Louvre. Every single time there is a new minister of culture since Bonaparte, the Minister of Italian Culture asks for the thing to be given back to it. And it never

worked, because it's big, because the tradition is there, and possession is right, so to speak. So I had the idea of asking Adam to do a perfect facsimile.

Now of course facsimile seems to be a word that says things superficial like a poster, which is actually what the Italians believed it. But it was Adam's facsimile. And Adam, when he makes a facsimile, it means that it's going to explore the inner quality of a painting at, especially in three dimensions, to a level of detail and interest which is way beyond, I was going to say way beyond Veronese himself, who was one of the many painters of the painting actually. So here you see, at night, the team of Adam making a 3D scan for about a week, pixel by pixel of the whole, of the whole *Nozze di Cana*, and then bring it on a canvas.

[00:56:58] We invented, Adam invented many machines to print on a canvas with the digital file. And basically robbed the original of the Nozze di Cana from the Louvre without the Louvre noticing it. To this day, the Louvre believes we have the *Nozze di Cana* in the same room, and now look at it. Look, this is a real situation. No Japanese there, no *Joconde*, no air conditioning, no doors, no frame. It's just in the place where it was made for. It's on canvas. It costs not very much. And it's not protected by a guard. And that's the original. That's the second printing of the original, so to speak. And that's a great thing.

And when, at the day of the inauguration, all of the Venice people were there, the Cardinal was there, they were, I mean, a sort of fountain of jewels there. And they were expecting a poster. And then the white canvas fell, and they saw this, and they were in tears. Because they realized that the aura, this famous aura which is supposed to be associated with the work, original work, had moved secretly from the Louvre to Venice. And it's still there. And if you ask people in the Louvre what happened to the Nozze di Cana, we don't, it didn't even, it's a perfect robbery. It's the absolute robbery, thanks to a highly-digitalized, an amazing involvement inside the inner quality of the work itself. I think it's a good way to finish on the possibility of art and science. Thank you very much.

[00:58:59]

David Kaiser It's my great honor to introduce now our final speaker for this afternoon's session-- our commentator, Professor Tomaso Poggio. Professor Poggio is the Eugene McDermott Professor in MIT's Department of Brain and Cognitive Sciences. He's also co-director of the Center for Biological and Computational Learning, a member of the Computer Science and Artificial Intelligence Laboratory-- or CSAIL-- and a member of the faculty of the McGovern Institute for Brain Research. He was originally trained in theoretical physics, and he's one of the founders of computational neuroscience.

He pioneered models of the fly's visual system and of human stereo vision. At the biophysical level, he and his colleagues developed models, suggesting that dendritic trees and synapses play a key computational role. Among his best known papers, Professor Poggio developed the mathematics of regularization networks and applied learning theory techniques to bioinformatics, computer graphics, computer vision, and neuroscience. He has also developed an influential quantitative model of visual recognition in the visual cortex.

Among a very long list of honors, Professor Poggio is a member of the American Academy of Arts and Sciences and a founding fellow of the American Association of Artificial Intelligence. His research has been honored with such awards as the Otto Hahn Medal from the Max Plank Society, the Max Plank Research Award from the Alexander von Humboldt Foundation, the MIT 50K Entrepreneurship Competition, and many others. In 2009, Professor Poggio received the prestigious Okwawa Prize for outstanding contributions to the establishment of computational neuroscience. That same year, 2009, he was elected a fellow of the American Association for the Advancement Science. Please join me in welcoming Professor Tomaso Poggio.

Tomaso Poggio OK. So thanks, first of all, to the organizers, to CAST, to Caroline. When I was in high school, I loved the literature and philosophy, and I loved to write somewhat personal cosmic visions about God and the world. But then my Latin and Greek teacher-- I was in a Jesuit school-- told me to stop dreaming, to stop playing with words, and stop being inebriated by them.

He told me to confront reality and do something concrete. It was really a big crisis for me. And he made me getting to mathematics and physics.

So Einstein became my hero. And the question soon-- one on my many types of curiosity-- was, what made Einstein a genius? What is intelligence? How was the brain of Einstein creating Einstein's equations and theories? Could we replicate Einstein in a computer?

And so this was the question of human intelligence that drove my scientific life, which I spent basically between brains and computers. And these are also the questions ultimately addressed in the new center for Brains, Minds, and Machines, of which I'm the director. And in a way, I'm not yet asking about-- unfortunately-- about collective intelligence, how to improve decision-making in human societies, decision about climate change, but we are doing, we hope, preliminary work leading to those questions.

[01:03:21] Very much in the spirit of this CAST symposium, intelligence and even common sense begins with seeing, sounding, and sensing and today is the seeing day. So let me tell you what the center does and plans to do. After all, I'll tell you some thought about research, education at lot of institutions like MIT.

You can ask why focusing on the problem of intelligence. Why now? And we're optimistic that this is the time to try again because of the observation of the progress in the eye, many due to advances in machine learning, has led to the very recent appearance of machines that mimic human performance, and they're even better than humans in their domain of intelligence.

What you've seen here is the advertisement of volvo a couple of years old about a vision device in Volvo-- you could buy it-- which is braking if you come too close to a pedestrian or a car. This is a product of Mobileye which is an Israeli company started by an ex-student and post-doc of mine, which became public three weeks ago in the New York Stock Exchange. So these are things that work, make a difference, will make a difference in everyday life.

And there are, of course, other similar systems that are better than us in certain domains of intelligence, like Deep Blue, which won against the chess master 10 years ago. This is a drone taking off from a carrier, and last year it landed on a carrier, which is probably the most difficult thing that a human pilot can do. And then, of course, there is Watson beating human champions at Jeopardy.

So there are these systems that are better for us in certain domains. None of them could answer the questions that every one of you could answer about an image like this one. You can ask simple question, like what is there? Who is there? What is this person doing?

Eating, more complex ones. What does she think about the faults of the other guy and about her? Or tell me a story about this simple scene.

You all can do that. There is no machine that can do that today, and certainly for several years. And so it is the time to try to make some progress on understanding how our brain can do that, can in a sense have human intelligence, common sense in answering a lot of broad, different questions-- for instance, about a scene or a video.

These are the questions we are trying to understand in the center for the next 10 years or more. And the center itself-- the Center for Brains, Minds, and Machines-- started about a year ago, and its focus is on the problem of intelligence. This is a big and ambitious project.

The problem of intelligence is, I think, the greatest problem in science and technology today. There are other great problems, like the nature for life, the origin of the universe, the structure of matter and energy, but I think intelligence is the greatest of all. This is my personal belief.

I think it's the problem for this century, like molecular biology was for the last half of last century in physics for the first half of the last century. It's now time to try to do some basic research to begin figuring out how brains-- especially human brains-- compute. This is really trying to understand the nature of ourselves, our mind, and eventually how our mind interacts with each.

[01:08:08] So why can we do that? Well, I think we believe that we are at the time in which there is a convergence of at least three disciplines that are needed for making real progress in understanding intelligence. One is, of course, computer science, machine learning. But then there is in neuroscience and cognitive science. This requires different scientists with different backgrounds, different expertise in different areas from different institutions. And so this is what our center is drawing upon not only different institutions like MIT, Harvard and others, but studies that come from computer science, neuroscience, and cognitive science.

And we are beginning to develop system that can pass a variation of the Turing test for vision. So system that should be able to describe eventually, seen like the one there, answer your questions, simpler one-- what is there? Who is there? What is the person doing? More complex one, like describe the scene itself.

And should be doing this not only at the level of behaving like a person does, but also at the level of in the models themselves of having model neurons that behave like neurons in our brain do when they answer these questions. And one of the first questions I think we may be able to answer is the one, who is there? This is face recognition, where we know areas in the human brain that are involved in answering and recognizing faces.

We know homologous areas in the monkey's brain. We can record from neurons in the monkey's brain from these areas. We have models that can actually explain the behavior of these neurons, reproduce it, and perform like humans in recognizing faces. So that's one of the first, as I said, easier questions we may be able to answer at all these different levels.

More so, there will be some progress in machine learning. This is more of the technology side, is contributing to machines that could learn more like humans do, from very few examples and not from a lot of labeled examples, like Google and Big Data, like also the Mobileye system I showed that was trained with millions of pictures of cars and pedestrians labeled by teams in India. That's not how you train a child to recognize a car, showing one million pictures one at a time, saying this is a car, this is not a car, and so on. So that's the next phase of machine learning hopefully.

And I think that the problem of learning how to make computers learn is at the core of what we want to understand. Learning is a key part of intelligence, and it turns out that learning also offers foundational results,

mathematical results that are almost philosophical and tell something about science and known science and about the process of science itself. Consider systems that learn from data, from examples, and developer models from data, like a scientist does, like machine learning systems do.

Now in learning theory, there are theorems the state conditions that are necessary and sufficient for the ability of these models derived from data to be predictive. What does that mean? Consider, for instance, a cartoon.

Newton makes the observation of the apple forwarding and writes f equal ma, and then the rest of mechanics. Science is about theories that do not simply explain the data, but predict new ones. So in Newton's case, f equal ma not only explains the motion of the apple, but predicts how other apples will fall from the tree tomorrow and predicts also the motion of planets.

[01:13:26.99] So from this theory of learning theory, in order for this to happen, for this generalization to happen, what needs to be is that the universe of possible theories, of possible equations that Newton drew upon, this universe must be fixed before the observation of the data, and must be small in some deep, technical sense. It's a kind of Occam's razor that plays a role here to ensure predictivity.

But interesting, there is a condition which is completely equivalent to this simplicity of the universe of theories, of possible theories, and it is that the process of finding the right theory from the data. So effectively, the process of science in our metaphor must be stable in the sense that most of the time the theories it chooses from the data should not change much when new data arrive, and only rarely evolutionary theories should be accepted. Under these conditions and under these conditions only we can have generalization that is science-- that is, for instance, astronomy.

Otherwise, we have astrology, we have economics maybe, history who can interpret data, can interpret the past, but don't say anything about the future. This is like the financial page in the newspaper which tells you what happened in the stock market. People were afraid of what they sold does not that people you tomorrow.

So especially it's important because this one, the ability to generalize, is the reason why science works in practice, why good science is closely intertwined with engineering and technology. MIT is a good case. And technology is one of the most powerful engines in human history, especially recent history.

Technology is having a key role in shaping our society and our future. I showed with the example of assisted driving, the Mobileye, the ad from Volvo, how science can impact people on future life. Many known scientists may think that basic research needed for understanding the mind is

irrelevant for our life and our societies, as useless as a rock climbing or skiing.

It's not true. Let me tell you a little story about the importance of basic research. 14 years ago, I went to Pavia. This is one of these little old cities in northern Italian, 30 miles from Milan. It's a very old university.

I got there to get a Laurea Honoris Causa because it was the bicentennial of the invention of the pila-- the battery-- from Alessandro Volta, from where the term of "volt" comes. The invention of the pila was in the year 1800, and so I had lunch with Countess Volta, the grand-grand-grand-nephew of Alessandro Volta. And the invention of the pila was really basic research.

Volta published a paper in 1800 in the Proceedings of the Royal Society, and it was a curiosity driven research to show that a claim of Galvani, a colleague of Volta, was wrong. Typical thing for a scientist to do. But think about it. The invention allowed for the first in history to produce electricity for more than a microsecond. Until then, there were sparks and nothing else.

[01:18:00] So the original pila volta produced 2.1 volts for about two minutes. But this was enough for scientists to start studying electricity. And so 20 years later, the older electrochemistry was done. 30 years later, there were electrical models in generators and telegraphs.

Volta himself designed the telegraph line between Pavia and Milan. And imagine the times. Volta was made Count by Napoleon in 1804. Until Volta, information travelled at the speed of a horse, and the same speed for many centuries.

It's actually very interesting. There was a big event in 1450. 1450, Constantinople fell to the Turks. It was about the Columbus was born in Genoa, my city. And the news of the falling Constantinople reached Vienna and Paris and Madrid. It was big news, so there are many letters that people wrote and that still exist when they heard the news. And so you can see that it took three weeks for the news to get from Constantinopolis to Vienna, four to Paris, five to Madrid. This is a horse travelling 24 hours a day.

The moral of this story is that much of the changes in our society come from our technologies, and many of them-- indirectly, all of them-- come from basic research. The story about Volta that I told you also suggests that the process of scientific discovery is, of course, quite a bit often a random walk driven by social convention and interactions. It has strange features, like, for instance, epidemics of ideas. Sometimes good, sometimes bad.

It was said-- I think it's still true-- that there are about five or six basic strands of influenza viruses, and each one comes back around every 20 to

25 years. It's clearly why. Now it's interesting, there are similarly epidemics of ideas.

There was a great study a few decades ago about epidemics of ideas in the field of symbolic logic. This was based on the church bibliography from the period of 1847 and then other ones until 1962. And you see that the first real epidemic activity, a flurry of publishing of papers happened around 1900, and this was really Bertrand Russell Mathematica being published. Then the next epidemic peak is in 1930, and was basically killed off this activity by Godel's work. And then there is another one in '57, but all spaced around 25 years.

There is a similar one in the field of AI caught into my personal observations. There was an AI epidemic in the '60s when the term artificial intelligence was actually invented by Marvin Minsky and John McCarthy. And then the effective meme came back around '85 under the name of neuro networks. And now it's occurring again 25 years later under the name of deep learning, and leading to Facebook spending hundred millions of dollars in buying companies that do machine learning, and Google doing the same.

So if I go back to our center-- our center is involved in research, education, outreach, tech transfer. And together, they really represent creation and dissemination of knowledge. This is, I think, the real deep justification of our institutions like not only our center, but like MIT, like CAST. I can say it best if I give you a little parable about genes and technology.

Let us consider the evolution of our species. It is a little bit camouflaging myself just for a few seconds as a cosmic thinker. Of course, you know about natural evolution, about Darwin, about mutations and natural selections. You may know that evolution is not only the evolution of individual organism, but really the evolution of the genes-- the selfish genes of Richard Dawkins.

[01:23:06] And the concept of the gene is really profound, but my point here is that genes cannot explain by themself the evolution of mankind. There are also ideas-- Richard Dawkins called them memes-- that, like genes, can compete and cooperate and mutate and conserve. Ideas spread like the flu does. I mentioned before this epidemics of ideas.

They replicate, they evolve, they are selected. Some are good, some are bad. Some ideas, of course, are technologies, and our technologies are by now an integral part of our evolutionary fitness. By now, the evolution of mankind is inextricably bound with cultural and technological evolutions. So we are co-evolving with the organization and the artifacts and the technology that we have created.

So at this point, you may ask, what are the common features of genes and memes? Of course, what makes them the units of evolution? And so Richard Dawkins answers that they are replicators. They produce.

The unit of evolution is the replicated gene or idea. And I can try now to push this argument a bit further. We know that the mechanism that allows genes to replicate is the double helix structure of DNA and, of course, several molecular repair mechanisms on top of it, because by itself, they are already too large. There is sexual reproductions and so on.

What about the mechanism that allows for ideas to mutate and reproduce? And as you may guess, I think that it is teaching. It's really educational learning institutions like MIT that makes it possible for ideas to spread and replicate. Learning institutions replicate and mutate ideas, so they are a hot spot in the fabric that determines the evolution of culture and technology.

Some of our institutions have been selecting and replicating, and improving on powerful ideas for a long time, and have been very good at disseminating them. And so I think that fundamental task of organizations like the CBMM and like CAST is really to mutate-- this is the research-- but even more importantly, to spread ideas. And so to have a small, but possibly important, role in the future of our society, its evolution, and playing a role in confronting with challenges to our societies like climate change, this is, I think, what Bruno Latour and Caroline and the organization of CAST would like us to do. Thank you.

[01:26:15] **Question & Answer**

Caroline Jones: So we are going to take questions. And we hope to involve people sitting in the overflow room, so we'll take the first questions from this room, and then we'll try to alternate if people are coming from the outside, to speak to their questions. So we have on the table the universe, information, means, assemblages, efforts to change sensitivities to the largest ideas that we have such as Gaia, the planet, alive with us in it. So first let's see if any of the speakers thus far have any questions, or Dave as the masterful introducer of us have, have any questions or comments? No? All right.

Audience: Not yet.

Caroline Jones: Let's see. Great. So there's a hand here. Yes? Wait for the mic, thank you.

Audience: I was struck by how different both propositions about what knowledge is were in the two speakers. And I'm wondering if you think they're compatible.

Caroline Jones: If I personally think they're compatible?

Audience: No, no, it's an open question to the panel.

Caroline Jones: So we have neurons and their simulation, and we have a model of knowledge production on a planetary scale. How can we bridge these problems of scale?

Bruno Latour: We have Napoleon in the two talks.

Caroline Jones: We have Napoleon.

Bruno Latour: In the two talks, Napoleon arrives. So there is a connection.

Caroline Jones: So there's the connection. [LAUGHTER] When I demanded that these two individuals speak in the same panel, they wouldn't necessarily have combined themselves in that way. And I myself thought, is there a way to think about thinking that changes the way we think? So in some sense, that would be my common ground. And they have very, very different answers about that.

So both of them are confronting the problem of prediction, how can the human who pretty much is equipped to think about actions that have direct consequences, maybe you think about a generation, your grandmother, your grandchild, beyond that we're extremely handicapped in thinking about deep time and thinking about changes that are accumulated across very different bases of knowledge. This is one point that you made in your writing, that climate science as a whole has to be assembled from many, many different kinds of scientific practices.

Bruno Latour: Creating a link in the notion of learning. I read lots of papers by Professor Poggio, and the insistence on the learning. And I also read one other thing, which was at the beginning of the paper today, which is about category-making, and the fact that you don't need an endless number, so it means that there is a hierarchy that at least the organisms have lots of other ways of getting in than just having indefinite numbers of tokens, which is a traditional question of philosophy. Neuroscience is interesting because it's philosophy under other means, so to speak.

So all the traditional questions, what is a type, what is a token, questions which have been discussed in Pavia in the 12th century, are back into the laboratory with much better tools, of course. So the general questions of, I mean, I have no idea what knowledge is in general, but the insistence in Professor Poggio's work on the fact that learning is the key to understand the dynamics is, in that sense there is a vague relation between my Jamesian work, after all James was a great psychologist himself long before the neuroscience came in. But the movement is still taught in psychology class.

[1:30:58] This idea that you have to start from action and apprentissage. I mean, the learning is the [1:31 UNINTELLIGIBLE]. So it's a movement by which you learn, which is the key phenomenon. And that's very much related to what we heard in the session before with Professor Conway about the stability and time of lots of the things we take fixed [in terms of color], but in fact we

are lateral. I mean, that's the idea of James. We are not face-to-face, we are in the throes of experience. And Professor Conway showed that lots of features of color are actually time dimension and not space dimension. And I think that here is some sort of common interest, of course, with vastly different skills and competencies.

Caroline Jones: Yeah, so I'd like to introduce a question that perhaps addresses this issue of learning, because most of the models that the MIT neuroscientists operate with are the computer processor. They're circuits, they light up, little pulses go through them from one place to another, the architecture of that circuitry is imagined as fixed. And yet there's this concept of neuroplasticity, some of which is coming out of French neuroscientists, which involve the actual production of neuronal material on an ongoing basis from a certain kind of soupy, this gets back to Tomás Saraceno's talk on spider silk last night.

I mean, another, there's a somewhat undifferentiated material in there which actually resembled neonatal cells. So how can a machine apparatus imagine or model this incredibly plastic, ongoing experiential form of learning, which has everything to do with being in the world? So this is, in a way, a question for you. Is this something that you're grappling with in the intelligence initiative and attempting to find the models to grasp that ongoing –

Tomaso Poggio: Yeah, I think, you know, the, as I mentioned, the key to understand intelligence, especially human intelligence as opposed to the intelligence of even insects, which by the way do surprising things, but are, and I'm speaking, oversimplifying, are much more hardwired by the genes than we are. In our case, the genes, but also experience plays a big role. And experience means plasticity, means learning. And, but the knowledge with computers should not be taken too, you know, too strictly. Computers can also learn. There is a lot of machine learning in our life today, starting with Google. You know.

It has been learning to do search much better than any human librarian could ever do. And this is based on machine learning. So you don't need to have a soup in order to do learning. If you can change bits in a memory, that's learning. I think, you know, I've always disliked, you know, I admire our biology department, but years ago I kind of disliked the imperialism of the genes. This, especially these stories about twins, identical twins that, you know, had given the same names to their daughters, that of course were very similar to each other and so on. I found that a little inhuman, if we have so little control on our future. Fortunately, I think, you know, there is learning. Each one of us, of course, is conditioned by the genes, we can do a lot to make himself or herself different and better.

Caroline Jones: And there's also Napoleon.

Bruno Latour: I think there's an interesting, I mean, the Volvo case struck my philosophical background because of course it's a very Kantian way. I mean, technically, that is. You frame the little pedestrian moving in the car. And I mean, it's a classical case of categories, I mean, straight out of Kant. But if you then add, which is what we do in our field of science that is the whole institution around which makes the Volvo plus your laboratory plus the patent of his, plus etc., we shift from Kant to another more science studies base, philosophy so to speak.

[1:36:02] So I'm not too worried about the, I mean, it would be really amazing if all of these guys who are paid a lot, with all the laboratory, were not able to make a machine think. I mean, it will be a waste of money. It should not be, it should not be so complicated to have prosthesis of that sort. I mean, we have prosthesis for glasses. I mean, I admire the fact that now when I take a picture and I see this little frame in the face, it's coming, now I know it's coming from your lab. I'm delighted to see a sort of instantiation of Kantism into the machine.

So for us in science today, it's not [1:36 UNINTELLIGIBLE] machine. Of course they will. I mean, we are so bad at so many things. And if it could be supplemented, we have rulers to make, I mean, it's not more extraordinary to have rulers in order to make, I'm not talking about rulers in the White House, I'm talking about rulers. So I think the task is not to say, is the machine going to be doing this or not? I mean, this is of course not what you are doing. Because in your papers many times you criticize me of the old model.

What is interesting is the layering. Of course, brain scientists are great at layering. And I like the aesthetics of your model when it uses lots of boxes and arrows etc. to show the layering, and we heard some of that. So layering is something which is very much a genre, an aesthetic of proof which is spread out as well in the history of science sociology. It's not that different, even though of course again the skills are completely different.

Caroline Jones: I should be looking for the next question. Are there any from the overflow room? No. OK, so here's a question in the third row from Carrie Lambert-Beatty, who's going to be put in this position tomorrow afternoon.

Carrie Lambert-Beatty:

So this is maybe just a way of rephrasing some of the questions that have already come up, but maybe you can help me understand a little bit more, Professor Poggio, about thinking that your example of the photograph of people having an interaction, and the question of, how can a machine learn to recognize the things that we see when we look at it, right? How that sort of bounces off of Professor Latour's discussion of new kinds of sensitivities that we need to develop, right? So that you're talking about, my understanding of it was how to make the machine sensitive to the things that we are already sensitive to. But it seems like Professor Latour would be

asking your kind of work to instead teach us different ways to be sensitive. Is that possible? Is that part of the way that you're –

Tomaso Poggio: Yeah, I think it may be possible. I don't have an answer of how to do this right now. You know, as I said, I think the work we are doing, maybe a help would be a preliminary step in that direction. First to understand what we can sense right now, you know, common sense. It's essentially, what I'm saying is human intelligence, not at the level of, you know, the champion of chess, but at the level of each one of us. The kinds of things we can, each of us can do. And then once we understand that, we may understand how to convince people to fight for climate changes. I'm not sure whether it will be, you know, convincing people, or trying to make everybody a bit smarter. I don't know if that works. This will be an interesting question. You know –

Carrie Lambert-Beatty:

I guess my question would be more, is there anything about how machines think that humans could learn from?

Bruno Latour: But there is another way to do it, which is I am working right now with geoscientists, who call themselves specialists of critical zone, which are basically river catchment, highly equipped. And their point is that it's not the number of cars in the street, because the cars in the street is a highly formatted, and you see quite easily how you could even more format it as soon as you add a few categories, which are represented by the rectangle around the faces. But when you, and we are here, geophysicists who are very worried because they say for health, we have amazing numbers of monitoring instruments. We monitor every single, when you enter the hospital in the, what is the name of this television series, Urgent? It's called Urgence in France.

Caroline Jones: Emergency Room.

Bruno Latour: Emergency Room, yeah. You rush the patient immediately, and they say, we are geophysicists, and they say we don't have, we don't even have a good instrument for PH. It's very difficult to calculate PH real-time continuously, on a critical zone. Give us instruments. So you will have another science policy here, because instead of asking a machine that will end up being Volvo-compatible, you will shift a lot of the energy of scientists, people who make instruments, who thus render us and the citizen sensitive to what is happened to an environment. In the case of a critical zone it will be river catchment different. So the building of our sensitivity, the building of aesthetic is also a question of science policy. And this, I mean, I should not say this here because this whole institution is entirely sort of made around –

[1:41:39]

Caroline Jones: We're the frackers. We're the frackers.

Bruno Latour: OK, well, a certain set of questions which are the ones which is supposed to be important. But there are also others for which the building of instruments is absolutely essential. So I think the charming artist who spoke before was asking for medicine in order for drugs. I'm making another plea, because here there are lots of inventors at MIT, for helping the geophysicists to build the instrument, just one, just one for PH. Continuously, making us sensitive to PH.

Caroline Jones: Right. So there are, right, so there are two notions of sensitivity. And one is actually highly prosthelytized by machines. We can't see the wellhead gushing when Deep Horizon breaks. But the machine can, right? So we have a lot of machines that suddenly reveal to us what's going on at the very deepest part of the ocean, so on and so forth. So that's one kind of sensitivity. It's a sheer index of energy happening, oil flowing out of some broken pipe.

The other kind of sensitivity is a certain emotional valance. And this goes back to the afternoon's discussion about color, right? How do we become caring about the information that is already produced by the machines? How do we become, how do we assemble a political and an emotional, you know, activity around this caring? I mean, that's just one interpretation of the sensitivity that I think can be read out of some of your work.

Bruno Latour: I would, no, I mean, I would disagree with you. The idea's not, I mean, if this is a commentary on what I said, I don't want that to be the gloss on what I said. Because the thing that, in the case of being sensitive to the, Veronese's thickness, that has nothing to do with sensitivity, with emotion. It produces emotion, but –

Caroline Jones: Well, in fact my emotion doesn't care at all about the Veronese, so you know –

Bruno Latour: No, it's there, but as moved when I read Tomaso's paper about the many layers of the brain, I mean, emotion should be put outside of the discussion if my point is being understood, which is that the two aesthetics, none of them is especially more emotional than the other. The discovery of the world by the science, the instruments of science, is just as emotional. That is, if emotion is taken etymologically as what makes us move.

The question is the difference in the instrument to make us sensitive to it. And that's where the cooperation, I think if we re-divide between those who are emotional and the others, actually in the piece of the afternoon, the argument of Conway was not that one is subjective and the other, he wanted to avoid it, and you did it actually in your introduction, to avoid the primary-secondary distinction which has been the ban, the bane, sorry, of philosophy since the 17th century. Again, Locke. Again, too many still lifes. So I think that emotion comes in all of the instruments.

Caroline Jones: Absolutely. I'm simply saying that sensitivity –

Bruno Latour: That there are some instruments –

Caroline Jones: Sensitivity itself is already accomplished by certain machines which we do not attribute emotion to, and yet sensitivity as a word also has this connotation which you may or may not want to own, but it is there in a linguistic –

Bruno Latour: It is, to make one's self sensitive. So if you make a Volvo sensitive to a pedestrian, it's just as emotional as if you make yourself sensitive to Veronese because you have found a three-dimensional way to make it reproduced, in my argument. An emotional Volvo is a Volvo equipped with the instrument that Tomaso invented.

Caroline Jones: This is going to become a meme, I predict. So I think there's a question, one more question. OK, question from overflow. Yay.

Audience: Thank you very much. Professor Latour, I've read much of your work and I've noticed that you've taken a distinct, as Professor Kaiser mentioned, a turn towards a more constructivist approach, or rather a mode of constructive critique, as emphasized in, From Matters of Fact to Matters of Concern. And I know that's also coincided with a shift in your career towards university administration. And I was listening the other day to your meditation on a bust of Emilio Bootme. And I was wondering if you felt that there was a relationship between those two things? Was it a mere coincidence? Or how did that work, from your own experience?

[1:46:16]

Bruno Latour: Well first, congratulations for having graduated from the room there to this one. And while I've been a terrible administrator, I was actually a more sort of entrepreneur, which as you know doesn't exist in your language. But I was an entrepreneur of [1:46 UNINTELLIGIBLE], and I created a very tiny, tiny, tiny media lab, and that sort of thing. I was not really doing administration. But I learned enormously from an organization. I'm not sure I found if it's a shift in my career, no.

It's just that I wanted to, I was with scientists before in a very small, something that, a place which was very sort of stuffy, training engineers, I mean, a bit like MIT, but very small, again. And I moved to another group of people who are now doing political science and know nothing about science. So I just switched camps, so to speak, but I did the same thing twice. With the scientists, trying to make them understand a little bit of society and politics, and now I'm trying to do the reverse. But it's not, it was not a sort of Damas [or in English, Damascus] situation. If I understood your question, which I might not.

Caroline Jones: Well, thank you all for staying with us so late into the day.