

Induction Ceremony

Challenges Facing a Global Society

On October 7, 2006, the American Academy of Arts and Sciences inducted its 226th class of Fellows and Foreign Honorary Members at a ceremony held in Cambridge, Massachusetts. Meteorologist **Joanne Simpson**; biomedical researcher **Paul Nurse**; civil-liberties advocate and authority on constitutional law **Robert Badinter**; actor, writer, and director **Alan Alda**; and physicist and business and foundation leader **Fred Kavli** addressed the audience. Their remarks appear below.



Joanne Simpson

During the past fifty years, meteorologists have made spectacular progress in their field. My generation was lucky to be part of the great advancements in both the science of meteorology and its technology – such as computers, Doppler radars, and satellites – which were spurred in part by World War II and the Cold War. But because of the importance of climate and weather to human life, politics and politicians have specified the goals for meteorology.

In the early days, when I started out, resources were bountiful: projects could be funded by a phone call or a single-page letter. Weather modification was a fashion until the late 1970s, when the decision makers deemed it a failure and it faded out. Fears that the Soviets could be ahead of us in applications of cloud seeding, however, gave birth to cloud physics and to considerable parts of my own work on cloud models, guided by aircraft observations.

But earth-science research, of which meteorology is a part, is now in a crucial situation. During the past two decades, resources allotted to earth scientists and to earth science have dwindled, with an increasingly rapid decline over the past six years. As a result, the basic infrastructures of research and the attraction of star scientists into the field are in danger.

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The damage done has serious consequences. I don't see any successors to the likes of Jack Bjerknes and Carl Rossby, both members of the Academy, whose thinking on atmospheric processes changed the basic concepts of their field in the twentieth century. The keyword here is "thinking," creatively and critically. Nowadays, because of the need to compete for scarce funding, meteorologists are so consumed with writing proposals that few have a chance to *think* as their predecessors did. Today I can point to just three or four great meteorologists who have enough energy and talent to do their research, to nurture their students, and to protect them from political hassles. Their students, in turn, become mentors of still another generation of scholars, but this is a fragile linkage, with a small population as in endangered wildlife ecologies.

Moreover, meteorological support is currently weighted heavily toward technology and computer-prediction models, which aim at applications rather than basic understanding of the atmosphere and the ocean. Because the technology is expensive – with those who provide funds expecting a quick return in applications – the new remote observing tools and powerful computers are often overpromised in terms of their immediate value to forecasting.

Nevertheless, there is reason to be optimistic about the future. I base this on the twentieth-century advance from laborious hand observations to machine-produced information from sophisticated remote sensors and models. With the Internet, many of these data sets are freely available to anyone with the time to use them.

Still, we have to be more willing to provide more unfettered funding to scientists with creative ideas, even when the future applications of their research cannot be foreseen. The technologies are but tools for creative, dedicated scientists, not ends in themselves. To improve understanding of the complex processes that control the atmosphere and the oceans requires that the human brain be in an environment where the science itself is a high priority.



Paul Nurse

The title of my remarks is “In Defense of Doubt.” This might be thought a rather unusual theme for an address to an Academy dedicated to the cultivation of the arts and sciences and the advancement of intellectual understanding. One might imagine that such an Academy should be working to reduce doubt rather than defending doubt. In contrast, my intent is to argue that doubt should be encouraged. It is a critical step in the pursuit of knowledge, particularly scientific knowledge, and a proper recognition of the significance of doubt is also important for the interactions of science with society, and, for that matter, for society as a whole.

My starting point is the eleventh-century French monastic scholar Peter Abelard. He identified doubt as a crucial step in the pursuit of truth when he stated, “By doubting we come to inquiry, and through inquiry we perceive truth.” What Abelard meant by doubting was the recognition that all is not known with certainty about the world. Doubting embraces a skeptical approach. It challenges the views of established opinions and authorities; and doubt, together with curiosity, forms the mainsprings promoting the pursuit of knowledge. Maintaining a skeptical approach during inquiry also leads to respect for observation, experiment, consistency, and the development of ideas that can be tested and are therefore capable of refutation – all of which are core attributes of science.

This emphasis on doubt and skepticism contrasts with views of the world based on faith and beliefs, which do not depend on empirical support derived from direct evidence or proof but rather depend on testimony or authority, and so may consider doubt of little value or even as a weakness. Such views are often associated with more fundamentalist religious beliefs, and the difference in these two approaches is the basis for the present debate over creationism as an explanation for the diversity of life. Creationism depends upon received authority for its support, and therefore is not subject to doubt or refutation, both of which are central to scientific inquiry.

How can we deal with the mismatch between what society expects and what science can deliver? I would argue that the way forward is to encourage public dialogue, openness, and honesty.

Doubts can also become marginalized when grand ideologies are too zealously embraced, becoming excessively self-referential and incapable of refutation. Two examples of ideologies that many have argued suffer these problems are those developed by Marx and Freud. Ideologies such as these and faith-based thinking have and will continue to provide important insights, but when they are used as the only prism through which the world should be observed and understood, then intellectual impoverishment is generally the outcome. Doubt, in contrast, encourages both a diversity of ideas and a healthy skeptical approach, which helps test the validity of ideas, a surer way to arrive at reliable knowledge.

I have emphasized the importance of doubt and skepticism for scientific inquiry, but, interestingly, society generally views science as lacking doubt. The great ideas of science have usually been subject to prolonged investigation and testing, and having survived such intense interrogation, they become ac-

cepted as highly reliable explanations for the world around us. This is how we teach science in schools, and it's how we scientists often portray science in the media, encouraging society to view science as always dealing in certain knowledge. Long-standing and well-tested ideas should have such a high status, but this does not always apply to many problems of science under current investigation, problems in which society may have great interest. Examples in the area of biomedicine include the causes, treatment, and prevention of disease; the genetic basis of behavior; and the influence of diet and pollution on health. Frequently, research in these areas falls in the category of tentative knowledge. But such hesitant understanding is unsatisfactory to society and its leaders who are seeking, quite understandably, greater certainty. A current example is whether the bird flu virus will cause a human influenza pandemic, a question which most scientists working in the area find very difficult to answer. But clear advice about whether or not this is likely is of great importance to governments and to the public, which are wrestling with how to manage a potential major threat to public health.

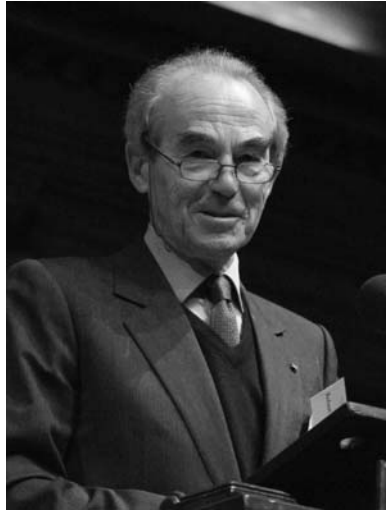
This disconnection leads to a problem for interactions between science and society. Society is looking for certainties and believes science can usually provide them, while science is often in a state of tentative knowledge at the edge of understanding and cannot always provide the certainties required in the time frame they are needed. The problem is exacerbated when less than scrupulous political leaders take shelter behind poor science, or declare good science “junk,” in order to bolster either a particular political opinion or to support specific commercial activities. An example of the latter are those who deny the evidence of climate change and argue that it is junk science, when their real motive is to protect the oil industry by promoting a society based on high-energy consumption. I believe the future will judge this debate in much the same way as we now view the tobacco industry's denial that smoking causes cancer.

How can we deal with this mismatch between what society expects and what science can deliver? I would argue that the way forward is to encourage public dialogue, openness, and honesty. A willingness of engaged scien-

tists to talk and listen to the public about the issues; an openness to explain the true nature of scientific inquiry and the knowledge it produces, which can range from very reliable understanding to far more tentative explanations; and an honesty to admit when we are unsure and cannot provide the clarity requested. This last point can be a real issue with the coverage of science in the media, because the wish to provide differing views – and perhaps less laudably, the entertainment of observing a confrontation between individuals at polar opposites – can lead to the excessive exposure of fallacious ideas held and presented by zealous individuals lacking not only doubts about, but also support for, their positions.

I want to take my defense of doubt just one step further, to the healthy functioning of society on a global scale. Real dangers threaten the world when those with intolerant fundamentalist religious or ideological beliefs come to political power or have too much influence on those in political power. Their lack of doubt leads them to believe that they are always in the right, producing groups, governments, and regimes who do not listen to the opinions of others, who are not interested in dialogue, and who turn all too readily to military or violent interventions to impose their orthodoxies on others. We are in real need of greater doubt in today's world, not only for the advancement of knowledge and its effective use for the benefit of humanity, but also to make the world a safer place.

Francis Bacon, the seventeenth-century English architect of the Scientific Revolution, eloquently summed up the argument I am making when he said: "If a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties." I commend this passage to us all and to the world's political leaders.



Robert Badinter

I love constitutions. A good constitution represents a political instrument, a legal architecture, a historical episode, and a literary work. Reading the most beautiful ones gives me the same pleasure as reading a literary masterpiece. Whenever I read the French 1789 Declaration of the Rights of Man and the Citizen, it sounds to me like the overture of *Don Giovanni*, considering the tragedy that will follow. And I always marvel at the preamble of the American Constitution: "We the people of the United States. . . ." I want to stress that the founding fathers, the American children of the century of Enlightenment, are to constitutionalism what Bach is to music – giants.

I am convinced that there is an art of constitutionalism. Some constitutions succeed in combining political vision, efficiency of institutions, and clarity, sometimes even beauty, of legal style. Others deserve only the oblivion in which history has buried them. France, in this regard, offers a vast collection of samples. In more than two centuries, the United States has known but one Constitution and twenty-seven Amendments. During the same period, the French people have lived under three monarchies, two empires, five republics, thirteen written constitutions, and innumerable amendments. The product of a passionate history, crossed by revolutions, constitutionalism in France, like our cuisine, has become not only part of the culture but also, in some way, a national art. Strangely enough, Napoleon Bonaparte, on the days following his coup d'état, called into his office the best

constitutional experts of the time. They explained their views, Bonaparte listened, and at the end he said, "All of this is very interesting, gentlemen, but you must remember that a good constitution should always be short and obscure. . . ."

Through the years my passion for constitutionalism has not lost its intensity. A constitution is not a police regulation. It proceeds from a certain conception of power, in a given society, at a specific moment, to fulfill certain requirements. Take democracy. Democracy remains, through various formulas, the government of the people, by the people, for the

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people. But this sovereign principle can be expressed in many institutional ways. It can be federal, like in Germany, or centralized, like in France. It can be parliamentary, as in most European states, or presidential, as in the United States. It can use popular referendums, or ignore them, like in Germany. It can even be a monarchy, like in England or Spain. But a good democratic constitution should in all cases fulfill two requirements: respect the fundamental freedoms of the individual, and satisfy the needs of the society that it will rule.

This explains, I believe, why the success of the Philadelphia Convention of 1787 could not be achieved by the European Brussels Convention of 2002. Indeed, there are striking and obvious differences in the two conventions. In Philadelphia, only thirty of the fifty-five delegates from the thirteen states

were present in the rather small twelve-by-twelve-meter chamber. In Brussels, 105 delegates from twenty-eight old nations, plus 102 deputies, were present in the huge session room of the European Parliament. In Philadelphia, sessions were held *in camera*. In Brussels, they were open to the media. If you look at it, the Philadelphia Convention appears more or less like a general commission in a parliamentary assembly, deciding over majority vote, while in Brussels, this huge crowd of delegates had to reach consensus.

But the fundamental difference lies elsewhere. The delegates in Philadelphia wanted to go beyond the Articles of the Confederation and find a new formula that would, at the same time, protect the prerogative of each state, while overcoming the difficulties of living and acting together as one state on the world scene. On the contrary, most national delegates at the Brussels Convention just wanted to improve the existing European treaties, but certainly not give birth to a new state, the United States of Europe, the real dream of true European believers, among which, I confess, I rank. This lack of political will explains the deceptive result, unless you agree with another explanation given to me by a good friend, a brilliant member of the English Parliament: “Robert, do you know why success was not reached here in Brussels where it was in Philadelphia? It’s obvious. In Philadelphia, they all spoke English and none of them were British. . . .” After all, when you come to think of it England has been for centuries a major power on the world scene and guarantees the freedom of its citizens without a written constitution. What a blow to a constitution lover!



Alan Alda

I know everyone in this room is very smart. So, just for fun, I’m going to give you a question from an IQ test. See if you can answer this. I’m going to read you a list of names. Which one stands out as odd? John Adams, Benjamin Franklin, Thomas Jefferson, Charles Darwin, Alan Alda.

Does anyone need extra time?

I can’t tell you how much it means to me to be invited to become part of this institution, and to be included among the extraordinary people who represent the humanities and the arts – disciplines that express some of humanity’s most probing questions. It’s amazing how life on Earth has come up with these questions in such a relatively short time.

It wasn’t long ago, not even a tick on the cosmic clock, after we first appeared on this wet rock spinning through time and space, that one of us first put his handprint on the wall of a cave. Whatever else it meant, that handprint said, “I’m here.” But even before that, there must have been dancing and singing. There must have been vocalization, the hubbub of community, the glee of existence. All this, I think, was the birth of the arts.

We made notches on sticks to count and keep track of things, but the notches that we made in our *brains* were the crucial ones. We began parsing our language so that, in a string of sounds, the *order* of the sounds had meaning. This let us communicate the huge difference between “My foot is on the rock” and “The rock is on my foot.” At that point, we could start parsing not just our words but the world

itself. We could go from the statement of “I’m here” to questions like “*Where* is here?” “*What* is here?” “What’s that over there?” and the big one, “Who am *I* who is asking all these questions?” That, I think, was the birth of the humanities.

All I mean to say by this fanciful romp through prehistory is how happy I am to be included among the historians, philosophers, philologists, those who engage in the study and practice of literature, and all the other representatives of the humanities and arts who are gathered here today. We all belong to the same brotherhood. We have all traveled different paths in search of an answer to a

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question that has nagged us for thousands of years: *what does it mean to be human?* Together with our colleagues in the sciences, we’ve searched endlessly for an answer to that question: what does it mean to be human? It may be the most critical question we’ve ever asked in the life of our species, especially *now*, when our ability to destroy ourselves is so much greater than our ability to understand ourselves.

I know artists best, so let me talk about artists for a minute, but I think the humanities and the arts share many of these attributes, as do the sciences. Here’s what gets me about artists: I’m touched by their courage and their generosity.

This is what it’s like when you decide to be an artist: In the first place, you don’t *decide* to do it. You’re kidnapped by it. You never know if you have what it takes. And after years of doing it, you’re always back where you started, a beginner. Because every time

you head for the horizon, it's not there. An artist looks at life and the chaos of nature, then takes a brush, a violin, a camera, or his or her own body and plays a plaintive song of desire on it, a desire for understanding. Who are we? Why are we the way we are? Can we ever become what we wish we could become?

All artists, I think, are like poets – whether they arrange words on a page; make steel and stone into buildings; or leap into the air, transforming their bodies into visual music. The poet puts the right words in the right order so that the colliding of their sounds and meanings make your neurons flash like a pin-ball machine. And like the poet, artists of all kinds take the viewer's nervous system and snap it like a whip. They refresh our vision. They press our reset button. They make the colors of the world as vivid as they were when we were children and saw them for the first time.

Artists try to say things that can't be said. In a fragile net of words, gestures, or colors, we hope to capture a feeling, a taste, a painful longing. But the net is always too porous, and we're left with the sweet frustration of *almost knowing*, which is a teasingly pleasurable experience.

We often tune ourselves to the oscillations of nature: the rhythmic beat of the heart, or the sea running up the shore and then pulling back, or the bang and slam of the shutter in a storm. From these elemental rhythms spring the one-two beat of music, and the push and pull of the play on words. They're the antagonist and the protagonist of drama. They're the essay's ebb and flow of argument.

We ride this rhythm, and it rides us. Like a windsock in a heartless gale, the artist whips back and forth to the beat of nature, free of care and sometimes just as free of safety. I love my fellow artists for the dangerous life they lead, for the exhaustion of their birth pains, and for how they bet their lives on the slim hope that they can make something worth looking at or listening to.

We may amuse and delight, but like Shakespeare's clowns, we also ask the most pertinent questions about who we think we are. Where would we be without artists? We would be gray automatons in a gray landscape picking gray flowers for gray lovers. Life would be grim.

And where would we be without the humanities? Life, I think, would seem far more meaningless. The search for wisdom – and for a deeper understanding of who we are – is the daunting challenge for the humanities. They are that part of our common brain that reflects on our actions, questions our desires, and forces us to declare what we value. In some ways, we're *all* artists – practicing our skills, but also reaching into the dark for an answer.

In the dark of the cave, we hope to find light – not from the torch, but from the sparks that fly as we decode the handprint on the wall. I wish us luck, and I'm so very grateful to be included among you, one and all.



Fred Kavli

I think of this day as a celebration of human curiosity, of our hunger for knowledge, and of human ambition, all of which are strongly represented in this learned and distinguished group.

Often, our thoughts about the most fundamental matters are inspired by our contact with nature. While growing up in Norway, I would ski across the vast, white expanses of its quiet mountains. At times, the whole sky was aflame with Northern Lights, shifting and dancing across the sky, down to the mountaintops. In the stillness and loneliness of the mountains, I pondered the wilderness, the planet, and the wonders of man. I am still pondering. The universe, so big beyond imagination, yet composed of particles so small beyond comprehension. And those little creatures that have taken command of the planet Earth, not because of their strength, not because of their longevity, but because of their brains.

After traveling a long road from the white mountaintops of Norway and a long journey through the business world, I have come back to where I started, to the universe, from its smallest building blocks to the vast and incredible wonders of space, and to the emerging master of nature, the human brain. I have come to support basic science because of my curiosity, and because I believe in its long-range benefit to humankind.

Basic science is the exploration of the unknown, the cutting edge of knowledge. Science is driven by human curiosity. But the

desire to learn penetrates all life, from the viruses that have learned to hide inside the cell's nucleus; to the bacteria that work as individual cells when they are alone and hunt as a pack with higher efficiency when they have adequate density; to the kitten that constantly tests and explores and gets into trouble; to the human being. So we see that the process of learning is basic to the survival of life, from the simplest organism to the most complex.

The best science, the science that produces the most important breakthroughs, is more likely to be driven by basic curiosity than by short-term benefit. Scientists were not motivated by practical applications when they developed the quantum theory of matter. And yet, that research led to, among other results, an understanding of electronic con-

Today we are witnessing the resurgence of philanthropy, as more and more entrepreneurs apply their fortunes and skills for the benefit of humanity in so many important fields. I think the most exciting fields of the twenty-first century are astrospace, nanoscience, and neuroscience – the biggest, the smallest, and the most complex – all of which I'm supporting through the Kavli Foundation.

Let us celebrate human curiosity in science, the humanities, the arts, business, and philanthropy. Let us support the urge to explore, to gain knowledge, and to pursue confidently our daring search into the unknown. ■

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duction in solid-state materials, which led to the invention of the transistor, making possible the development of integrated circuits, computers, the Internet, and the IT world in which we live today.

Similarly, when Crick, Watson, and Franklin discovered the double-helical structure of DNA, they didn't know the extent to which it would revolutionize our understanding of biology and open the door to remarkable advances in medicine.

I believe there is a strong relationship between the level of our nation's science and its technological and industrial leadership in today's high-tech world. It is important that our leaders in government duly recognize the importance of investing in research, which yields enormous benefits to society through improved standards of living, better health, and stronger national security.