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AAAS WILLIAM CAREY LECTURE
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It's a great pleasure to be with you this evening. Of course, when you're an ex-Congressman it's a great pleasure to be any place where someone is willing to listen to you. I think it was S.J. Perelman who joked that "nothing recedes like success," and once "former" is the most important word in your title, you begin to get a sense of what he meant.

But seriously, it is a special pleasure to be here because one of the great privileges of my chairmanship of the Science Committee was that it gave me countless opportunities to meet with, and learn from scientists – including the ones on my own staff. The late Kurt Vonnegut once defined the "information revolution" as the "idea that people could actually know what they're talking about, if they really want to." And I know from personal experience that there's no better way to begin to bring about that information revolution than to find out what scientists have learned about our world.

Which brings me to what I'd like to discuss in tonight's talk. In the program, the talk is titled "The Outlook for American Science" because at the point when AAAS asked me for a title, I had no idea what I was going to talk about, and that title seemed like it could cover just about anything. And it could, but what I want to focus on tonight is not "science policy," per se, but rather the involvement of scientists in the whole range of policy decisions that require scientific information – environmental policy, health policy, you name it.

So a more precise title for this talk might be "The Role of Scientists in Policymaking" or maybe something like "Policy Makes Strange Bedfellows."

Either way, one important point is implicit in those titles. Scientists should participate actively, even avidly, in policy debates. Indeed, both as educated citizens and as professionals with relevant knowledge – not to mention as beneficiaries of public support – scientists ought to feel obligated to contribute to policy making – in their communities, in their states, in the nation, and even in the wider world.

At the federal level, that is more important than ever. In Washington these days, especially in the Congress, just about every issue imaginable is framed as a science question. That's because, in our highly polarized political environment, describing your position as the only scientifically valid stance is perhaps the only remaining way to seem more "pure," more convincing, more above the fray than whomever you're sparring with.

This can frankly be a mixed blessing for scientists and science. On the one hand, it provides an opening for scientists; politicians want, or at least think they want, to hear from scientists because they're faced with so many technical decisions and because science is such a powerful and omnipresent way to frame policy questions.

On the other hand, this very framing means that the way to attack an opponent's position is to attack the science that is supposedly supporting it, to charge that it isn't real science – which would be, by definition, "pure." This phenomenon has made science a weapon as much as a tool in policy making, not an especially healthy development. We run the risk of loving science to death by first putting it on a pedestal, and then ripping it down.

There ought to be a way out of this vicious cycle of elevating and derogating science, and politicians and scientists are going to have to work together if we are to find it.

What is to be done? First, both scientists and policy makers have to be more careful about defining policy issues as scientific questions. In most cases, science has to inform policy making, but it isn't determinative. Pretending that science is going to settle a dispute that is really about values or money or anything else just leads to muddled thinking and distorted debates that are damaging to both science and policy in the long run.

Let me give you one of my favorite examples. In 1997, the Clinton Administration proposed toughening the clean air standards for ground-level ozone – a move I supported, by the way. The science around ozone at that time was pretty clear – elevated ozone levels increased hospital admissions of people who already had respiratory ailments, but ozone didn't seem to cause chronic problems or kill anyone. There was broad agreement in the scientific community on the curve that predicted what level of excess hospital admissions would result from a particular ozone concentration.

So really the question that confronted policy makers in setting an ozone level was: how many hospital admissions are acceptable public policy? This was a simple, direct and horrifying question, and no one wanted to go near it. So the debate was framed around a very different question: "What ozone level is scientific?" The real answer was "there is no such level;" it's a policy question, all the science can do is tell you the probable consequences of whatever level you pick.

At the beginning of the ozone debate, scientists would sometimes make that point. But by the end of the increasingly vociferous debate, when the rhetoric had become highly charged, and when Congressional hearings had degenerated into little more than keening sounds as Congressmen begged scientists to just tell them an ozone number, well, let's just say that the idea that selecting an ozone standard wasn't a science question got kind of lost. And in the end that was damaging to science because it meant that the battle was fought by each side attacking the other's science and scientists rather than having an open discussion about policy.

So, for starters, I urge all the scientists in this room, as well as the policy makers, to try to be clear about what's a science question and what's a policy question. The line isn't always clear, of course, but that's not a reason not to try to make a distinction.

I don't mean to suggest by this that scientists should stay out of the policy aspects of a debate. As I said at the outset, scientists ought to be visible participants in policy discussions. But they need to be clear about when they're speaking as scientists and when they're speaking as citizens, and they ought not try to impose an orthodoxy on the scientific community on policy questions. The fact that a scientist is opining on a policy question doesn't mean that what he or she is saying is "science."

There's a corollary to all this for scientists: Don't assume that everyone with the information you have would reach the same conclusions you do. This is a fallacy I describe as "if you knew what I knew, you'd think what I think." There are a million examples of scientists and policy makers differing on the implications of scientific knowledge. One could start with the divide that opened up between many of the scientists who developed the atomic bomb and the officials who didn't share their sense of terror or pacifist inclinations. The environmental arena abounds with cases like this where scientists are surprised when some find value in an altered ecosystem.

A recent, widely discussed article in Science took a somewhat different tack on what I've just discussed. In a "Policy Forum" piece titled "Framing Science" and in a related op-ed in The Washington Post, Matthew Nesbit and Chris Mooney argued that (quote) "[S]cientists must learn to actively 'frame' information to make it relevant to different audiences."

I don't particularly disagree with Nesbit and Mooney's proposals for the specific issues they discuss. And I appreciate that their article is based on the premise that giving the public more scientific data doesn't inexorably lead to public support for a scientist's policy view. (Nesbit and Mooney assume, though, that all scientists share the same policy views on key issues and that the world would always be a better place if the public went along with the policy views offered by scientists – faulty assumptions, in my book.)

But my fundamental concern about the article is that Nesbit and Mooney are, without saying so, basically offering advice on how scientists should frame arguments on what are largely policy questions – what to do about climate change, whether to support stem cell research – not

science questions. They're silent about any distinction between science and policy, which is a problem.

Finally, Nesbit and Mooney seem to assume that the only audience that ever matters in science-inflected policy matters is the general public. And needless to say, in a democracy, what the public thinks, especially about broad policy issues is kind of important. The great essayist E.B. White once observed, "Democracy is nothing more than the recurrent suspicion that more than half of the people are right more than half of the time."

That said, especially on issues that have a technical component, the public may look to its elected leaders, among others, to provide some guidance, and elected leaders have a responsibility to know more than the average "man in the street." Often, the audience for scientists, especially early on in an issue – before the debate is "mature" – often then, the audience is a handful of key, interested policy makers who are trying to gather essential basics. They need to hear as much scientific information from as many angles as possible, not carefully framed, focus group tested, policy arguments.

(Let me add, as an aside, that one sign that the debate on an issue is at a "mature" stage is that the actual language of the debate is immature. In mature debates, everyone already knows what everyone else is going to say, few minds can be easily changed, and invective often replaces analysis. Nesbit and Mooney come close to assuming that all debates are at that stage.)

I won't say more specifically about the [Science](#) article, but I do want to emphasize one other point that may be at odds with the sense that scientists could take away from Nesbit and Mooney. I think it's vital that scientists be extremely open about levels of uncertainty when talking to policy makers.

Let me add here that I also think it's vital that policy makers understand that there is always uncertainty, and that uncertainty is not always a reason to defer action. I have long cited former Governor Kean's line from the 1980s about acid rain. He said, "If all we do is continue to study the problem, we're going to end up with the best documented environmental disaster in history."

But the fact that politicians may misinterpret uncertainty or that interest groups may misuse it – a pattern set by the tobacco industry, as many have documented – that is not a reason for scientists to mask uncertainty. That will only backfire. Look, for example, at how controversial the "hockey stick" graph became, at least in small part because scientists began to talk about it without describing the uncertainties that were laid out in the original paper.

But more importantly, you need to understand that the critical swing votes on any difficult policy issue are not going to be the loud-mouths at either end of the political spectrum. The key votes are going to come from moderate Democrats and Republicans who are more likely to do their homework on the details of an issue. And to retain your credibility with them, putting aside all the other reasons, scientists have to be open and clear about uncertainty.

And that political insight – if I may call it that – relates to the final piece of unsolicited advice I want to offer, which is this: If scientists are going to be more effective participants in the policy arena, they have to do their homework and learn more about the policy world. That isn't all that hard to do; the political arena is, after all, supposed to be comprehensible to the average citizen. At the most basic level, all you need is access to a decent newspaper and some Congressional websites.

And I would hope that, beyond learning the specifics about a Member or a piece of legislation, that delving into the policy world would lead to a greater appreciation of all the conflicting pressures, concerns, ideas and issues that politicians have to study, juggle and, ideally, master as part of their job.

Congressman Rush Holt, who is a physicist, has a great way of describing what he felt his day was like when he first came to Capitol Hill. He said he felt like a television set on which other people were constantly changing the channels. But my point here is not merely that political life can be busy and chaotic; it's that policy makers have to consider every aspect of an

issue and hear from every interested community. Listening to scientists is just one part of our charge because, as I mentioned at the outset, science is just one aspect of most issues.

The idealized picture of science – highly idealized, but still widely believed – that picture is one of a narrow, controlled space in which highly trained experts seek the truth through a method that filters out any idea that conflicts with objective reality. The idealized view of politics is quite the opposite – a wide open public marketplace where conflicting, but legitimate interests and ideas are ever in contention, and elected representatives of varied backgrounds and qualifications constantly temporize to find ways to balance the competing claims to move the nation forward.

Given such different worlds, it's not surprising that misunderstandings are legion, or that policy makers and scientists may, at times, treat each other with either excessive deference or contempt.

With that in mind, it should go without saying, that policy makers have to do their homework about science, just as much as scientists need to do some homework about policy and politics. And that means more than boning up on what scientists know about a particular issue. It means understanding the ways in which the scientific world is more nuanced than the idealized picture I painted.

To take just one example, Members of Congress tend to think of “science” as one undifferentiated whole. We are often baffled or caught unawares by the ongoing battles between different scientific subfields – battles that can have implications for policy decisions.

When Congress was reviewing the health impacts of particulate matter, for instance, very few, if any in Congress understood that part of the scientific debate they were hearing reflected the inherently different approaches that epidemiologists and toxicologists take toward understanding health problems. And I could come up with many similar cases.

Now, unfortunately, I don't know how to force anyone in either the scientific or political communities to do their homework. I try to do my part just by reminding both sides that the homework assignments exist. A careful, well informed media could hold both sides accountable if they failed to complete their assignments, but of course that just begs the question of how to develop and maintain such media. But that conundrum will have to be the subject of some other lecture.

In the meantime, we will have to rely on civic virtue, to use an almost antique term that nonetheless still describes what a healthy polity most depends on. Scientists and politicians will have to work to understand each other and to learn from each other simply because that's the only way to bring about the elementary, but still unprecedented “information revolution” that Kurt Vonnegut was calling for – that people would actually know what they were talking about.

As Vonnegut pointed out, for most of human history, humans lacked the tools to even develop information. Or as he put it, for most of human history, leaders have had to guess and guess and people have had little choice but to go along with their guesses. Russians who disagreed with the guesses of Ivan the Terrible, for example, were likely to end up in rather sorry condition.

So, we've come a long way. If we all just work at it a little more, maybe we can finally bring about that information revolution. Then all we'll need is some wisdom.

Thank you.