

## **SCIENTISTS' PERCEPTIONS OF OBJECTIVITY AND ADVOCACY: MAKING THE LINKAGE OF SCIENCE TO ENVIRONMENTAL POLICY**

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### **ABSTRACT**

There is no question that science plays a profound role in American public policymaking and that scientists are critical actors in the environmental policymaking process, serving as entrepreneurs, introducing, popularizing, and elevating environmental ideas onto national and international agendas. This article uses interviews with scientists to investigate the complexities of linking science to environmental policy, with special attention given to how scientists view the concepts of advocacy, objectivity, and the separation of science and policy. Because of the importance of scientists to the environmental policymaking process, it is worth exploring what they have to say about linking science to policy. Interviews of scientists in 1997 and again in 2009 illustrate the fact that scientists remain committed to the ideal of objectivity, struggle with the trend toward advocacy by scientists, and are distrustful of the way science is used in the environmental policy-making process.

### **INTRODUCTION**

It has been demonstrated quite conclusively that over the past several decades scientists have been critical actors in the environmental policymaking process, serving as entrepreneurs, introducing, popularizing, and elevating environmental ideas onto national and international agendas [1]. It was scientists who played pivotal roles in discovering and publicizing many of the environmental problems

that sit on our domestic and global agendas today. Scientists were the earliest and most powerful proponents of policies to address climate change, biodiversity, DNA research, and ozone depletion [2]. Surely, scientists have proven to be a major influence, some would say the “principal lever” [3], in changing attitudes about the environment, helping to reduce the influence of self-serving private and public interests [4].

Still, questions remain about the overall influence of science and scientists in producing effective environmental policies. The description set out below by Walter Rosenbaum points out the essential details of the science–policy conundrum as well as speaking to what some believe to be the key to solving that conundrum: determining what part scientists and science should play in the development of environmental policymaking.

Environmental policymaking is a volatile mixture of politics and science that readily erupts into controversy among politicians, bureaucrats, and scientists over their appropriate roles in the process as well as over the proper interpretation and use of scientific data in policy questions. [5]

Scientists, like philosophers, attempt to interpret the universe and understand it for what it really is [6]. Scientists also attempt to impart the wisdom of those interpretations to the greater society in hopes of bringing about meaningful discourse. Yet, because we live in a representative democracy, in the end, all policy decisions end up being political decisions that are filtered through the American policymaking process in the public sphere [7]. And therein lies the problem. Some (maybe most) public policy decisions involve complexities that go beyond the intellectual and practical capabilities of the public in general and policymakers in particular. The vastness of the knowledge required, the technicality of the subject, and scientific uncertainties all contribute to limitations in understanding for the very people who must ultimately make the final policy decisions. As noted by Roger Masters, science appears mysterious and threatening to the public at large, with scientific explanations of the world often appearing to be unrelated to the concerns of the average citizen [8].

Simply put, at some point in time most policy solutions are going to require input from scientists in one form or another. Scientists not only possess the expertise, training and knowledge required to provide such input, they possess the authority, legitimacy, and high social prestige to make such input valuable and meaningful [9]. Scientists are supposed to illuminate connections between choices and political outcomes and shape the public dialogue [10]. Still, we must remember that scientists are human beings and that science is not a separate entity, remote from society and the lives of people [11]. As put so eloquently by Arild Underdal, we do not expect scientists to be “devoted exclusively to the pursuit of ‘eternal truth’—in splendid isolation from the mundane concerns that plague governments and all other segments of society” [12]. In the democratic society in which we live today, there exists a basic need to have scientific methods

that are built around the experiences of people in living environments, as opposed to the closed environment of laboratory instruments [13].

This article explores the above listed complexities of linking science to policy in today's world, with special attention given to how natural scientists view the science-policy linkage. I do this because most research about how the public policy-making process works is conducted by social scientists with little attention given to the views of the natural scientists conducting environmental research. I wanted to ensure that natural scientists' views were prominent in the exploration of some of the large, philosophical questions concerning how science fits into the public policy-making process. Questions concerning advocacy, objectivity, and the separation of science and policy are not only pertinent to environmental policymaking today, but will remain pertinent in the long term. In the end, I let the scientists speak for themselves about the challenges of linking science to policy.

### SCIENCE, SOCIETY, AND DEMOCRACY

Science plays a profound role in American public policymaking. This is easily demonstrated by the fact that issues related to science are omnipresent in today's society [14], and by the fact that in today's rapidly moving society, science has been increasingly called upon to provide information to improve decision making in public affairs [15]. Science is called upon in this manner because it is conveniently designed to inform social policy; it serves as a language and reference point that allows for informed discourse about the nature and seriousness of societal risks [16]. Whether it involves the present-day focus on energy independence, nuclear waste disposal and the related emphasis on reducing greenhouse emissions, or the enduring questions involving biotechnology and genetic engineering, science mixes quite extensively with the everyday decisions of citizens and policymakers in our democratic society.

There appear to be no limits to the influence and power that science wields. The scientific process is cast as the most powerful instrument created by human mind [17], with an enormously powerful impact on our culture and society [18]. Scholars suggest that science is "man's greatest intellectual adventure" [19], one that has the power to determine the success or failure of all human purposes [20]. Science and technology have also been described as a possible remedy for the inadequacies of participatory democracy [21], even though science does not work through any sort of democratic consensus [22]. The idea that science is not just the best approach, but is the *only* approach to addressing issues involving the natural world—which by definition includes concerns about environmental protection—is pervasive throughout the scholarly literature.

## SCIENCE AND ENVIRONMENTAL POLICYMAKING

The views of Americans about the role of scientific expertise in governance have long been a source of disagreement and tension [23]. While scientific advice is considered to be “part of a necessary process of political accommodation among science, society, and the state” [24], democratic societies like the United States generally do not vest the power to govern to scientists; they vest it to nonscientists [25]. Frances Lynn, keeping with the widely perceived belief in maintaining a separation between science and politics, describes the most commonly accepted role for scientists in a democracy.

One could argue that the most appropriate role for the scientists . . . would be to self-consciously provide decision-makers and the public with as much information as possible about the uncertainties in his or her work . . . and place the very difficult decision of degrees of protection and the acceptability of a risk into the political arena, where, in a democracy, it belongs. [26]

No matter how you look at it, however, science and scientists are viewed as critical to environmental policymaking because scientific issues permeate all environmental problems and because scientists are often the first to discover and publicize environmental problems [27]. In fact, it is argued that environmental issues like the reduction in stratospheric ozone would not be part of the public dialogue without the influence of scientists [28]. In short, conventional wisdom posits that environmental questions are fundamentally questions of science [29], and that most environmental issues on the current agenda would not exist were it not for scientific research [30]. As Norman Miller puts it, “every environmental problem has, at its foundation, a scientific reality, and it therefore seems axiomatic that science must play a prominent, if not pivotal, role in formulating its solution” [31]. More to the point, Karen Litfin argues that the language of environmental policy debates is scientific in nature “because science is a primary source of legitimation and because scientists help to define environmental problems” [32].

At the same time, there exists recognition that it is not easy to translate the findings of science into reasonable public policies [33]. With all the importance allocated to science and scientists, questions remain about the ability of scientists to connect to a policy world that eventually relies on politicians to make the final policy decisions, with or without scientific input [34]. Simply put, science and scientists do not have the ability to resolve policy debates on their own no matter how good the science is determined to be and no matter how much faith we have in scientists and the scientific process [35].

## SCIENTISTS, OBJECTIVITY, AND PUBLIC POLICYMAKING

Science, at its finest, is meant “to provide value-free application of inductive reasoning to the material world that is distinguishable in its essence from the

morally charged revelations of oracles, prophets, and politicians” [36]. Traditionally, scientists—among others—have promoted this value-free nature of scientists as the “neutral, disinterested, and objective expert . . . the rational and authoritative arbiter of public debates” [37]. Those that support this view cultivate the image of objectivity [38], often heralding science as an objective enterprise populated by an apolitical elite [39].

This allure of neutral science, unaffected by the vagaries of politics, remains strong today. It is certainly true that “the ideal of value-free science retains its firm hold on the national imagination” [40]. President Barack Obama is illustrative of this belief. In one of his first radio addresses to the American people, he observed that promoting science meant much more than just providing money, it meant ensuring that facts and evidence are never twisted or obscured by politics or ideology [41]. Then, shortly after this particular radio address, President Obama again posited his belief in the objectivity of science, claiming that we must “make scientific decisions based on facts, not ideology” [42]. Clearly, the President of the United States holds close the ideal of scientific objectivity, especially as it applies to the American public policy-making process.

Objectivity, or at least the illusion of objectivity, is a source of strength for scientists [43]. Phyllis Coontz puts it this way: “While one may argue whether a value-free science is possible, objectivity continues to be the *sine qua non* of science, and according to such a view, scientific findings should be nonmoral in their application” [44]. Bruce Bimber concisely describes this vision of the science-policy ideal: “The idealized image of the scientific expert involves not only simply knowledge, but also a large element of objectivity, of being above politics and partisanship” [45]. Bimber goes on to suggest that it is this ability to appeal to non-political standards that provides legitimacy in the policymaking process. To label someone a scientist is to acknowledge the legitimacy of the scientific ideal [46].

Scientists are to be protected from the vagaries of values and must maintain their status as an invaluable social reservoir of disinterested, impartial, methodical inquiry, bowing only to the authority of reason in its unrelenting pursuit of truth [47]. Scientists are considered “neutral” actors with sufficient knowledge of the issue and experience to assemble a balanced perspective [48]. An ideal world is one in which scientists strive for a detached objectivity, an impartiality that is thought to facilitate the generation and interpretation of information in a neutral way [49].

### SCIENTISTS, ADVOCACY, AND ENVIRONMENTAL POLICYMAKING

Given the circumstances within which they must operate, scientists find themselves in a very precarious position. When scientists enter the policymaking world

there is never an explicit mention of values, although most everyone accepts the fact that it is often a deep difference in values and interests that motivates actors in the policy process, including scientists [50]. It is certainly understood by scientists that, at best, it may be inappropriate to publicly discuss policy ideas that possess a high degree of uncertainty [51], and at worst, seeking political victories through science diminishes the constructive role that scientific expertise can play in the policy process [52].

Scientists are often viewed as the only ones with the knowledge and ability to translate the rapid deterioration of the global environment into terms that will prompt outrage from the general public and action from policymakers [53]. Those who fear ecological destruction argue that scientists have an obligation to inform public policy, an obligation to become political players in the environmental policymaking process. Some observers even cite the failure of scientists to educate Americans about the dangers of ecological destruction as the primary reason for policy failure, contending that scientists need to stop pretending to be above the political fray or they will be consigned to irrelevance in policymaking [54].

There has been a call for scientists to come out of their laboratories and in from their field studies to engage directly in environmental policy decisions [55]. Scientists are being encouraged to speak out and become involved, to become spokespersons on matters of societal urgency [56]. Scientists are castigated for keeping themselves separate from society's challenges, resulting in the real possibility that their work may become irrelevant in the very arenas in which their findings might have the greatest impact [57].

However, many scientists are reluctant to become politically active, fearing that doing so would compromise their reputation for objectivity as scientists [58]. Scientists tend not to speak out because the flavor of the debate is so political [59]. A scientist's political capital is his or her reputation [60]. Many scientists believe that their status with other scientists is a good deal more important than their public image. The more an activist becomes identified with one end of the environmental spectrum, the more he or she is likely to be referred to as an environmentalist rather than a scientist [61].

## METHODS

Up to this point, readers have been exposed to scholarly work and journalistic writings to describe and explain how science gets linked to policy. Now it is time to hear from the scientists themselves. In 1997, I conducted a series of interviews with environmental scientists. Scientists from both the United States and Canada were interviewed: scientists who worked for universities, governments, or the private sector, and who had extensive environmental work-related experience. Specific results from these interviews have been published elsewhere and it is not my intention to rehash those findings. Instead, in the spring of 2009, I

contacted 15 of the scientists I had interviewed in 1997 and asked them to respond to some of the things they had said about science and environmental policymaking over a decade ago. I asked them if their views had changed, and if so, how. The idea was to gain a perspective of these scientists' views over time, and to see if there were any substantial differences in their beliefs after a decade of continued research concerning environmental policy.

In 1997 respondents were asked, based on their personal and professional experience, to respond to large, philosophical questions about the nature of the science-policy linkage—questions about how scientists perceived their relationship with policymakers, if it was possible for scientists to complete their research in an objective manner, and whether scientists should advocate for specific policy positions. The questions were open-ended, allowing scientists to talk about the science-policy linkage from their point of view. For the 2009 interviews I provided the respondents with their exact words (from their 1997 interview responses) describing a particular part of the science-policy linkage and asked them if their perceptions had changed. The results of these conversations are presented below. Tables 1, 2, and 3 list responses from each of the 15 scientists in 1997, followed by their thoughts from 2009.

I make no attempt to reduce the results to a numerical format. Instead, I provide what the scientists said in their own words. Hearing these thoughts and ideas from scientists directly involved in the environmental policymaking process is an excellent way to explore the complications, tensions, and complexities of attempting to successfully link science to policy.

## INTERVIEW RESULTS AND FINDINGS

The interviews of scientists in 1997 revealed three major findings:

1. few scientists believed that science had a strong influence on policymakers;
2. scientists (especially natural scientists) attached great importance to scientific objectivity and the need for separating science and policy; and
3. despite the risks of losing their credibility within the scientific community, scientists thought that it was necessary to advocate for policy positions that were supported by the scientific evidence [62].

Hence, I conducted the 2009 interviews in a way that allowed respondents to share their thoughts about these three findings, and I have organized the tables along those themes. The format is such that I first present the scientists' responses followed by my interpretation of those responses. While it is important for me to summarize the findings, I believe it is more important that readers be able to see the scientists' responses in their own words.

### **Scientists and Policymakers**

As the comments in Table 1 illustrate, the scientists I interviewed for this study still do not have much faith that policymakers listen to what scientists have to say unless it happens to fit policymakers' preconceived ideological positions. There exists a belief that scientists' input is generally "ignored, discounted, and changed." One respondent put it this way: "Scientists believe that no matter what evidence they provide, a politically motivated course of action will be chosen." Along this same line of thought, another respondent observed, "science by itself does not appear to have sufficient independent political power to get much done."

Part of the blame for this situation is put on policymakers who only get to see "highly filtered information" or simply "believe that the science they get is not objective but geared toward a pre-determined conclusion." Part of the blame is also put on the scientists themselves because they "tend not to speak out on policy issues" and "tend not to get involved in politics at any level of government." The consequence of this trend is quite straightforward: It is difficult to bring about change in the policy world if you refuse to participate in the policy process.

Respondents also note that the specialized training scientists receive restricts their ability to relate to the broader world of public policymaking. Such specialized training perpetuates a system whereby today's scientists fail to "understand the role of politics and decision-making," "continue to ignore opportunities to educate the public on technical issues and to become active politically," and often fail to see that their contributions are "only one part of the many pieces of the puzzle." The fact that academia continues to isolate disciplines into specific and isolated "silos" fosters the idea that science and policy are contained in separate compartments when we should be thinking about science and policy as proceeding together.

### **Scientists and Objectivity**

The responses cited in Table 2 give pause to those who project complete confidence in the objectivity of science. Yes, the faith in scientific objectivity holds true for many scientists, especially natural scientists. There exists a belief that "scientists can work completely independent of policy and policymakers." However, the predominant view remains that scientists must "think critically about the limitations of their scientific advice," and realize that science "is not the only variable in the equation for policy decisions." These beliefs coincide with some of the same insights provided from the responses listed in Table 1. That is, respondents feel that scientists, even if they believe that "science should be a bigger part of the decision-making pie," need to focus more on how science fits into the broader puddle of society as a whole and be intuitively aware of their own limitations and disciplinary assumptions.



Still, the goal of objectivity should not be pursued lightly or with the idea that objectivity does not matter. Just because scientists cannot detach themselves from their life experiences or achieve “true or complete objectivity” does not mean that scientists should not “strive for the highest level of objectivity [they] can achieve.” Furthermore, the concept of scientific objectivity appears to be perceived differently by natural scientists and social scientists. As one respondent points out, natural scientists “believe what they do is scientific and, as a result, objective,” while social scientists, “argue to the contrary.” In short, “skepticism about objectivity seems . . . to be much more common among social scientists.”

### **Scientists and Advocacy**

While most scientists now accept the idea that objectivity is an ideal rather an accepted truism, the move toward an increased body of advocacy by scientists has fostered an elementary split between those who remain committed to a separation of science and policy and those who argue that in order for science to be meaningfully connected to the policy world, scientists themselves must participate in the policy process. Table 3 documents typical responses representing the views of scientists toward advocacy. There exists a strong belief among many natural scientists that “scientists should not advocate policy positions,” that advocacy “cheapens science,” and that scientists are “no better able to weigh values and competing interests than folks in lots of other walks of life.” There exists faith in the scientific method and its ability to provide “objective” knowledge. Simply put, the perception among the interviewed scientists is that the “main characteristic that distinguishes science from policy is that science is supposed to be fact-based,” and “participating in and communicating peer-reviewed science is more useful than advocacy.”

Yet, there do exist a good many scientists who see a more nuanced policy world, one where scientists, be they on the environmental or the industrial side, “are laden with their own values and own personal biases.” Hence, scientists are asked to focus on providing transparency, to be aware of hidden assumptions and to make known any possible biases.

The views expressed in the responses delineated in the tables highlight the tension within the scientific community for scientists to be “guided by the data, not by values,” at the same time each scientist is asked to meaningfully participate in public policy discussions as “a caring human being.” As one respondent notes, “the boundaries are uncertain between what is proper advocacy and what is stepping over the line.” And therein lies the quandary for scientists, for there still exist grave risks for scientists who are perceived as advocating for specific policy positions. This is stated very clearly by one of the respondents: “The biggest danger with mixing science with policy is that you lose your credibility, trustworthiness, and reliability as a scientist.” In the end, however, if scientists have faith in their work and the peer review process and are certain of what they have to say, “then silence is not justified.”

Table 1. Scientists' Perceptions of Policymakers

**Scientist 1: Discipline (Political Science)**

*1997 Response:* Policymakers tend to listen if the science backs up what they like and sometimes when it gives them a way out. There is a common belief among natural scientists that if they do not change their work to match what policymakers want, then it is not used.

*2009 Response:* Some scientists do not understand the role of politics and political decision-making and cannot accept it when they see their science ignored, discounted, and changed. But sometimes I think scientists are so caught up in their scientific specialty that they do not understand that they are contributing only one of many pieces of the puzzle—and if it does not go just exactly how they think it should they cry foul. The big problem, I think, is a deep lack of trust: some political decision makers believe that the science they get is not objective but is geared toward a pre-determined conclusion, while some scientists believe that no matter what evidence they provide, a politically motivated course of action will be selected.

**Scientist 2: Discipline (Environmental Studies)**

*1997 Response:* Yes, policymakers do listen to scientists but don't very often find what scientists have to say by itself very interesting, very compelling. It takes something to put the policymaker on track and that is usually fear.

*2009 Response:* I don't think the world of science and policy has changed much since we last spoke. The reference to fear oversimplifies, of course. Positive opportunities can also be compelling. But science by itself does not appear to have sufficient independent political power to get much done.

**Scientist 3: Discipline (Environmental Studies)**

*1997 Response:* Scientists, for the most part, don't speak out. They tend to stay within their specific community and they tend not to get involved in politics.

*2009 Response:* What I said back then I would repeat today. I believe it is generally the case that natural scientists tend not to speak out on policy issues. And they tend not to get involved in politics at any level of government. Of course, there are exceptions to the rule, and you always find some at our universities and colleges who get involved in local water, land use, pollution, and other issues, join advisory bodies, and in general participate in public policy discussions and decision-making involving issues of science. But I believe these individuals still are not at all the majority. There is something in the training of scientists that has led to this situation, and I am not sure it has changed much. Ironically, even the anti-science Bush administration did not seem to reverse the situation. Scientists in government and those who are active in AAAS or the UCS or NRDC and the like do speak out, and sign petitions, and so forth. But I am amazed to see most continue to ignore opportunities to educate the public on technical issues and to become active politically.

Table 1. (Cont'd.)

**Scientist 4: Discipline (Botany)**

*1997 Response:* We really erode our political and public policy dialogue if we think of science and policy in separate compartments. Science has to clearly focus on the major policy questions. Yet most scientists do not know how to phrase the question or organize their research to answer the question.

*2009 Response:* My belief is that analysis of science and policy outcomes should usually proceed together. Many students do want to pursue this direction of work, but few get the opportunity due to the "siloiing" by academic departments. The result, in my view, is that risks to public policy dialogue have not changed, but rather that siloiing of academia presents huge barriers to all our work.

**Scientist 5: Discipline (Biology)**

*1997 Response:* When policymakers make decisions, they make it through filtered information. It is a complicated process but policymakers are very busy and have no time to read actual scientific reports. They read the executive summary after it is first prepared by scientists who summarize, then by interim people who simplify. By the time the information gets to the powers that be, they only get a flavor of the original science, which they never see.

*2009 Response:* I think I hit the nail on the head with my earlier response and that the situation is just the same as it was a decade ago. Regulations have changed (overall for the better) but regulators still deal only with highly filtered information.

## CONCLUDING THOUGHTS

Of all the possible outcomes of this particular study (as presented in Tables 1, 2, and 3), one of the more compelling findings is that the views of the scientists interviewed for this research project—at least with regard to the concepts of objectivity and advocacy—have changed very little over time. The thoughts and perceptions of the interviewed scientists remain guided by several basic ideas. First, natural scientists remain committed to the ideal of objectivity. Over and over again, natural scientists exclaim the view that science is fact-based and that objectivity is what separates science from all other methods of knowing. The reason why the public and policymakers have faith in science is because scientists, by working within the constraints of the scientific method, are viewed as credible, reliable, and trustworthy. Social scientists are much more skeptical of scientists' ability to conduct objective research. Having said that, most social scientists—like natural scientists—do feel that the pursuit of objectivity is a worthy ideal and that the tenets of the scientific process remain the best method of knowing about the natural world.

Table 2. Scientists' Perceptions of Objectivity

**Scientist 6: Discipline (Environmental Conservation)**

*1997 Response:* No, you can never achieve objectivity, never. Still, scientists should make the attempt because there should be some kind of separation between science and policy and we need to know what scientists are trying to tell us.

*2009 Response:* I feel the same way today, absolutely. Since we can't detach from ourselves, who we are, our genetic make-up, our life experience, etc., we cannot achieve true or complete objectivity. That being said, we MUST (not "should" but Must) strive for the highest level of objectivity we can achieve, if we claim to be scholars (including scientists).

**Scientist 7: Discipline (History)**

*1997:* Scientists should adhere to the model of objectivity, but at the same time scientists are part of the world as well.

*2009:* I would generally still agree with my comments from 10 years ago. I would, however, want to emphasize the following points: (1) That scientists should do their best to think critically about their own work and their own position in their institution and in society, and about how their scientific advice may reflect not just objective reality, but the particular assumptions that are inherent in their discipline, and also the wider ideas and values that form part of everyone's view of the world; and (2) That scientists also think critically about the limitations of their scientific advice, particularly its unavoidable uncertainties and areas of ignorance.

**Scientist 8: Discipline (Geological Sciences)**

*1997 Response:* In a perfect world science should just provide the results and consequences, but occasionally you get so frustrated by the lack of action that you go public to advocate. Scientists become so frustrated with the inability of the sheer weight of the evidence to produce action, there comes a time in your best judgment that the ends justify the means. Advocating pushes the science beyond credibility, although we are all guilty from one time to another.

*2009 Response:* The role of science was stifled in the last 8 years, and that perhaps we can look forward to a more open viewing of what science can contribute to decision-making. It is not the only variable in the equation for policy decisions, but it is certainly important to not fly in the face of accepted facts.

**Scientist 9: Discipline (Biology)**

*1997:* Scientists can work completely independent of policy and policymakers because their work has no policy application. Policymakers can make decisions without science but that is not good, especially with environmental policy as it is just too important to do without considering the science.

*2009:* Yes, I think it all still holds. Scientists certainly can do their work independent of policy: Science for science's sake. However, I still think science should be a bigger part of the decision-making pie, especially as it relates to environmental issues, when the stakes can be so high.

Table 2. (Cont'd.)

**Scientist 10: Discipline (Political Science)**

*1997 Response:* My perception is that natural scientists view themselves as being objective and social scientists are much more skeptical of this view.

*2009 Response:* I do still believe that. I still think natural scientists, for the most part, believe what they do is scientific and, as a result, objective. I think they are largely frustrated with social scientists or others who would argue to the contrary. They have great confidence that their methods and theories are objective because they can be replicated by others if they are sound, but that may just mean that other scientists are making the same theoretical mistakes and using the same biased methods. I don't think there are strong incentives for scientists to challenge orthodoxy; rather, the incentives are to become more expert and specialized. It is a hard thing to do for scientists to think critically about their assumptions and methods—true of social scientists as well—but skepticism about objectivity seems to me to be much more common among social scientists.

To remain true to the ideals of the scientific method then, we must find a way for scientists to maintain their independence from the policy world—a way for scientists to protect their scientific credibility. It is the faith we have in scientists to be above politics that gives credence to what scientists have to say. If scientists become bogged down on the policy-side of environmental issues, acting as any other political interest group, the very essence of their legitimacy is in danger of disappearing and their impact on policymaking marginalized. We cannot compromise on the integrity built into the scientific process. It is simply not worth it. If we lose the credibility that science provides, then the value of science to meaningful public policymaking is lost, and we will be the worse for it.

Second, natural scientists are very cautious when it comes to policy advocacy. Most reluctantly agree that advocacy is becoming more prevalent among scientists and most admit to some form of advocacy within their own work. However, most natural scientists claim a disdain for advocacy, claiming it cheapens science and causes confusion among the public and policymakers because—for the most part—people cannot distinguish between science that is fact-based (objective) and science that is value-based.

Third, both social scientists and natural scientists agree that the training scientists receive greatly affects how they view the world. Natural scientists do not like to speak out because from the very beginning of their training they are told that policy is off limits. To remain relevant in the scientific world, natural scientists must do everything in their power to retain their scientific credibility. Engaging in policy and politics only detracts from their scientific efforts. Social scientists, on the other hand, are trained to engage politicians, to enter the fray, to

Table 3. Scientists' Perceptions of Advocacy

**Scientist 11: Discipline (Engineering)**

*1997 Response:* Scientists should absolutely not advocate. We've even abandoned objectivity as a goal. Scientists ought to struggle for objectivity and show a disdain for advocacy.

*2009 Response:* I continue to believe strongly that scientists should not advocate for policy positions. The main characteristic that distinguishes science from policy is that science is supposed to be fact-based, i.e., it is supposed to rely on findings derived by the scientific method. In contrast, policy must consider additional "non-factual" factors, such as values and competing interests. In my judgment, scientists are no better able to weigh values and competing interests than folks in lots of other walks of life. Worse, when a scientist becomes a policy advocate he necessarily cheapens science, as his policy advocacy cannot be purely fact-based. Rational people hearing a scientist acting as an advocate have no way of knowing where his fact-based conclusions (i.e., his science) end versus where his own set of values and competing interests (i.e., his policy) begin.

**Scientist 12: Discipline (Biology)**

*1997 Response:* My personal point of view as someone who is asked to advocate all the time, is that I am uncomfortable because it is a real risk to one's scientific reputation to advocate on any issue. There is a difference between speaking one's mind and advocating. Being an activist is troublesome. What is really important is credibility and I do not want to do anything to jeopardize that by having a reputation for speaking out against government or industry policy. I believe I can be more effective with respect to an issue that I care about by taking a lower profile.

*2009 Response:* If anything, I feel even stronger than before that participating in and communicating peer-reviewed science is more useful than advocacy. Over the last 7 or 8 years I have seen a number of specific examples of industry funding arm's length, peer-reviewed research because it was in their interest to do so. This reflects a fundamental change in the way industry meets its environmental responsibilities. We are seeing a transition from "No I won't build a tailings pond on my mining operation because it will cost too much" to "I will build this tailings pond, but first I need a scientific evaluation as to whether the proposed solution will have the desired benefit." Industry is becoming aware that governments don't have the resources to do the research necessary to set realistic environmental guidelines. Instead government regulators rely on the precautionary principle. This inevitably means that the discharge limits are set to very low levels, lower than is probably necessary. As industry becomes more experienced in this area, they are increasing their funding of high quality research knowing that the Environmental Protection Agency and their equivalents world wide, will take them seriously. In short, partnerships are taking over from litigation.

Table 3. (Cont'd.)

**Scientist 13: Discipline (Environmental Studies)**

*1997 Response:* If scientists start advocating specific and controversial policies, they get into trouble and their credibility is questioned. It was all right for scientists to say that something needs to be done about the problem, that you can become an activist in that regard, but then scientists should let go and that is wise because if they get drawn into the emotional part of the policy argument, they get discredited.

*2009 Response:* The issue is how one defines "advocate". The boundaries are uncertain between what is proper advocacy and what is stepping over the line. Most climate scientists, for instance, advocate seriously addressing this issue. This is not generally seen as compromising their role as scientists. It is difficult also to define "scientist"; however, this type of creature is generally held in the public imagination to be providers of "objective" knowledge. Now there is no such thing as objective knowledge; however, as with advocacy, there are ill-defined boundaries, in this case, between objective and subjective. Policymakers and the public generally value scientists as purveyors of credible, trustworthy, and reliable (aka "objective") knowledge. When advocacy is seen to overly intrude on credibility, trustworthiness, and reliability, then a scientist may be in trouble. The biggest danger with mixing science with policy is that you lose your credibility, trustworthiness, and reliability as a scientist, though not necessarily as a caring human being. To me it is fine to get drawn into the emotional part; one can't help it. But, again, you have to figure out the boundary. In the environmental/sustainability field the boundary is shifting toward acceptance of stronger advocacy by scientists and will likely continue to do so as if these problems continue to get worse.

**Scientist 14: Discipline (Economics)**

*1997 Response:* Whether scientists should advocate for particular policy positions is a troubling question. Overall it makes a difference whether you are talking about natural science or social science. The first is guided by hypotheses and the second by a world view. Scientific findings should be based on the scientific method and not a world view. This distinction is important. While a world view can guide hypotheses, it should not affect the findings which are based on the data. Those are two different things."

*2009 Response:* I have changed my views since we last talked. I am more humble now. I understand that all scientists are laden with their own values and own personal biases. I also understand that all scientists, both on the environmental side and the industry side, want a certain result. If scientists are not aware of the hidden assumptions, it could be very dangerous. You have to know the inherent biases and respect them. There has to be transparency. If you are not careful it becomes a debate over who does the better science instead of the science itself. You always have to be aware you are looking through a lens and even if the data goes against your values, you have to be honest with what your data says. What you care about drives what you do. But you must be guided by the data, not by values.

Table 3. (Cont'd.)

**Scientist 15: Discipline (Environmental Studies)**

*1997 Response:* If you have enough validation of your work through the peer review process and you can be certain enough to say something, then silence is not justified.

*2009 Response:* I think my statement still stands, although I would qualify it that I think scientists are best to focus on articulating the policy outcomes that need to be achieved, as opposed to the detailed design of specific policy instruments and interventions needed to achieve those goals.

make a difference through participation. As suggested by one of the respondents, if the analysis of science and policy outcomes are to proceed together, maybe there needs to be a better appreciation for the importance of providing cross-disciplinary work for scientists in all fields. Broadening the scope of training and the awareness of the interconnectedness of the natural world to the policy world might prove a worthy endeavor, especially as it pertains to environmental policymaking.

Finally, natural scientists appear to have a substantial distrust of policymakers. There is a strong feeling among natural scientists that policymakers only pay attention to science that fits their ideological views and if scientists want to be heard they must change their science to fit a particular ideological view. These perceptions will not easily be overcome. However, as mentioned earlier, there are signs that the present administration is aware of these perceptions and has taken initial steps to emphasize the need for trusting in the ideals of the scientific process. In the final analysis, we turn to the words of one of the respondents as he pondered the role of science over the past eight years in hopes of looking forward “to a more open viewing of what science can contribute to decision-making.”

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