Our Moment of Truth: The Social Contract Realized?

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EDITORIAL

Our Moment of Truth: The Social Contract Realized?

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Abstract

Much has changed in the two decades since I (JL) proposed that scientists should re-examine their obligations to society in order to serve society better. Today, more environmental scientists are actively sharing their science broadly, conducting use-inspired science (*sensu* Stokes) in addition to basic science, engaging with society, and crafting solutions to problems not just diagnosing them—all very welcome and exciting developments. For the most part, however, environmental scientists have taken on these extra duties because they believed it was the right thing to do and despite the considerable impediments that exist within academia. But make no mistake, the culture of academia continues to impede progress. As a result, although the above actions have had demonstrable effect, their collective impact falls far short of what is needed if society is to tackle effectively the disruption underway due to climate change, ocean acidification, biodiversity loss, pandemics, and more. Actions by *individuals* can take us only so far. To truly help society meet its grand challenges, environmental scientists must now make a quantum leap in engagement with society. It is time for *strategic, collective action* to change the culture of academia and create the enabling conditions for science to serve society better.

1. Keynote

Welcome to our AGU Union Session and thank you for joining us. I (JL) am here today to challenge us to look in the mirror, ponder this Moment of Truth, and take stock of our responsibilities to society, each other, and future generations. I pose four questions:

- What is the social contract for science?
- Why is it important?
- How are we doing?
- What do we need to do?

Let us start with the first two. Twenty-two years ago, I focused my AAAS Presidential Address on 'Entering the Century of the Environment: A New Social Contract for Science' [1]. My remarks highlighted a plethora of serious environmental problems that were insufficiently addressed by the scientific community. We needed scientific answers that we did not have, and we needed to do a much more effective job of using existing knowledge. I noted that the culture of academia rewarded publishing scientific results in scientific journals, not connecting that knowledge to policy makers, managers, decision-makers, industry, or citizens. Far too much scientific knowledge was languishing in scientific journals and not accessible to or used by society. Confronting this conundrum, I asked, 'What are our obligations as scientists?' I suggested that, in exchange for public funding, scientists have an obligation to be more helpful to society. Specifically, we needed to do more than conduct great science that is driven solely by curiosity and do more than simply publish it in journals read only by other scientists. We *also* needed to focus on the scientific issues underpinning major challenges confronting society and share our results widely.

I concluded that we were not delivering on our social contract. The scientific enterprise was creating vast amounts of knowledge, but it was not collectively adding up to the kind of information that society could use to be informed about or solve big problems. I suggested that our social contract should include (1) a focus on wicked, urgent problems, (2) a

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commitment to share our knowledge widely, and (3) a pledge do so with humility, transparency, and honesty. The overarching goal I had in mind was helping society move towards a more sustainable biosphere, one that is ecologically sustainable, politically feasible, socially just, and economically viable.

I closed my AAAS Presidential Address with a Calvin and Hobbes cartoon by the incomparable Bill Watterson: Calvin, in his little red wagon being pushed through a forest by Hobbes, says, '*it is true Hobbes, ignorance IS bliss. Once you know things you start seeing problems everywhere. And once you see problems you feel like you ought to try to fix them. And fixing problems always seems to require personal change. And change means doing things that are not fun. I say phooey to that.* They start down a steep slope, with Calvin looking backward saying, *But if you are wilfully stupid, you do not know any better, so you can keep doing whatever you like*'. As their wagon picks up speed, Calvin muses, '*The secret to happiness is short term stupid self-interest*'. Hobbes, looking ahead shouts, '*we are heading for that cliff*'. Calvin, covering his eyes shouts back, '*I do not want to know about it*'. They fly over the cliff—'*Waaaaugh!*' Crash! Splayed on the ground with broken wagon bits all around, Hobbes mumbles, '*I am not sure I can stand so much bliss*'. And Calvin replies, '*Careful! We do not want to learn anything from this*'.

I loved and used that cartoon because it encapsulated the inertia in society and academia alike and the worldview of many that staying the course was the best option, when in fact, greater awareness and action to change course were sorely needed. Change is hard, but it was needed. With this call to re-examine our social contract, I intended to prompt a discussion of our individual and collective responsibilities and trigger action.

What has transpired in the intervening 22 years? Are we fulfilling our social contract now? If not, why not, and what is needed?

My answers are personal reflections, based on my perspectives as a research scientist, university educator, science communicator, and government official. My four years in Washington DC as the Under Secretary of Commerce for Oceans and Atmosphere and a member of President Obama's science team provided an opportunity to engage with citizens, members of Congress, industry, and civil society. The broad portfolio of the scientific agency, National Oceanic and Atmospheric Administration—that I led for four years—gave me insights into how science touches people's lives, and what they know and think of that science—from weather forecasting to climate change, from fishery management and aquaculture to protection of biodiversity and the benefits the ocean provides. My two years as a science diplomat with the State Department as the first U.S. Science Envoy for the Ocean provided additional rich interactions with scientists, industry leaders, decision-makers and citizens. Those experiences shaped how I think about science and society.

One of the most important and least appreciated roles of science is to inform people's understanding and decisions. And I do mean 'inform', not 'dictate'. Science does not dictate any particular outcome. Many scientists do not appreciate that numerous factors beyond scientific information influence the decisions made by both institutions and individuals. Policy makers, for example, often take into account politics, economics, values, and more. I believe that science should also be at the table. Science should inform their decisions—but it does not dictate them. However, all too often, science is not at the table because it is not accessible, understandable, or seen as relevant, or credible. For science to inform decision-making, it has to be all of the above. Part of our social contract entails scientists playing a more active role in making scientific information accessible, understandable, relevant and credible.

A few stories about my experiences with science and policy makers will illustrate these points. The first highlights politicians' attitudes toward science. About a year after I was sworn in, in the middle of the Deepwater Horizon oil spill disaster, the President asked the Vice President to go to the Gulf to meet with fishermen and share what the federal government was doing and what we knew about the spill. The VP's team invited me to join him and brief him on NOAA's and other agencies' efforts. I briefed Vice President Biden on Air Force Two about key aspects of the spill—how oil impacts life in the ocean, what we were doing to halt the flow and spread of oil and minimize its impacts. Part way through my briefing, the VP stopped me and said, '*Hey, I thought you were a scientist!*' I replied nervously, '*I am, Mr. Vice President.*' Then he responded '*But… I just understood everything you told me*'. A bit stunned, I thought '*Wow—what a commentary on other scientific briefings that was! How many times has he been briefed by scientists and he still thinks he cannot understand us*'? That interaction reinforced for me that far too many smart politicians think they cannot understand us. That's a problem. The VP embraces scientific knowledge and supports it. But, he still expects to not understand what we say. Once he realized that he and I could communicate easily, he peppered me with more questions and invited me to ride with him in his car after we landed so he could learn more.

My second story emphasizes the importance of not assuming your audience knows what you know about the topic. NOAA's National Weather Service provides life-saving weather forecasts and warnings and shares its weather data so others like the private

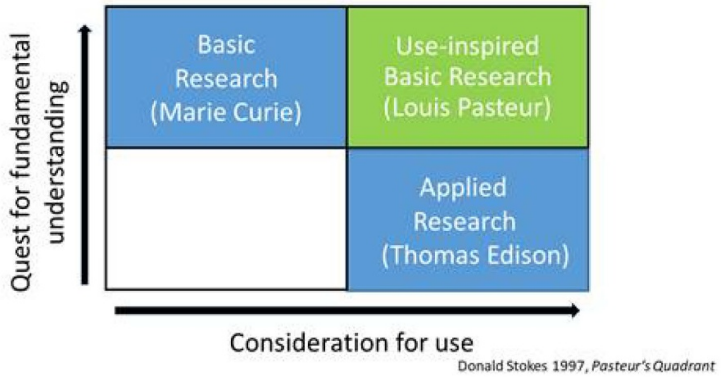

Figure 1. Use-inspired science.

weather providers can generate forecasts and various weather products. Over 95% of the data that go into the numerical weather forecasts come from NOAA's weather satellites. When I was at NOAA, after we completed a much-needed overhaul of the program that oversees construction of new weather satellites, I was on Capitol Hill to brief key members of Congress on the change. Since many of them were deeply immersed in the program, I mistakenly assumed they all knew the basics about how vital these weather satellites were to the entire weather enterprise. So I was unprepared when one key member scoffed at my pitch, saying '*Doctor, I do not need your weather satellites, i have got the Weather Channel*'! Unfortunately, neglecting to learn what your listeners know about your topic is a mistake we scientists often make.

So, 20-plus years later, how are we doing in rising to the challenge of our Social Contract? I believe we can take a lot of pride in the changes that have happened in two decades. Things are remarkably different in terms of the attitudes and actions of scientists. Here are four significant advances that we have made.

(1) Far more scientists today are actively communicating their science. They tweet, blog, post videos about their research, and speak to the media. SciComm is a 'thing' now. It did not used to be. There are now numerous programmes designed to train scientists to be better communicators, but the demand still outstrips the availability of good programs. Fortunately, social scientists have shared valuable results about how to communicate science effectively ('the science of science communication'); much of that is being put to good use. I think about science communication as learning to be bilingual—speaking the language of science and speaking the language of lay people. Avoiding technical jargon, telling stories, finding strong and useful analogies and metaphors, giving listeners a glimpse into your world, your passions, your feelings are all elements of effective communication.

I want to be clear that I am not suggesting that ***all*** scientists should communicate with the public. Some don't want to. Some aren't good at it. Some shouldn't do it. My hope is that we would all support our colleagues who do choose to communicate with the public. And we would all support our students who communicate publicly or seek to learn to do so effectively. We need to move past the outdated notion that younger scientists jeopardize their careers by sharing their knowledge widely. Rather, we should embrace, encourage, and enable all scientists who seek to connect science with society effectively.

(2) We have moved from doing mostly basic science to doing a combination of basic science plus what Donald Stokes calls 'use-inspired science' [2]. Stokes makes the case that the classical binary categorization of science into either basic or applied science does not do justice to the richness of the science that our world needs. He defines a third category, 'use-inspired' science (Pasteur's Quadrant—figure 1), as pursuing fundamental knowledge to solve problems that are immediately relevant to societal needs. More and more scientists are doing just that—tackling big, wicked problems and producing knowledge that can be immediately helpful. We need all three categories. But until recently, 'use-inspired' science has gotten short shrift. This is changing rapidly.

(3) Scientists today have realized that simply communicating scientific knowledge is insufficient; we need to also engage more with society. In my 1998 social contract paper, I focussed on *sharing* knowledge. I now realize that although sharing is indeed important and needed, it is not enough. We must also *engage* with society. We need to listen, to learn, and to co-create

knowledge with non-scientists. Indeed, more and more scientists are working toward this end.

(4) Scientists have moved from just diagnosing problems to devising and co-creating solutions. This often entails rich interdisciplinary interactions and partnerships with non-academics. These take time and often require special arrangements. Co-creating solutions is something that scientists had often shied away from, but are doing more and more today. There are a huge number of solutions that have been created in the last 20 years. These solutions provide powerful models to emulate, but most are far from being implemented at the scale needed to match the magnitude of the problem.

In short, scientists are responding to societal needs. They are moving from the ivory tower to embracing a social contract—whether they call it that or not—and moving to science being embedded in, engaged more with, and serving society. More and more environmental scientists are conducting use-inspired science. They are crafting solutions. There are a lot more of us, we are doing it better, we are learning from each other. Communities of practice now exist. This progress is thrilling. These individual scientists are fulfilling their social contract. However, as useful and important as their efforts are, the sum total is not yet commensurate with societal needs.

So why has this impressive progress been insufficient? My diagnosis is that these endeavours have largely been individual efforts. Individual scientists have broken stereotypes and expectations, because they were motivated to help. But, they have done so despite the reward structure within the academic system. For more scientists and science writ large to truly help society solve daunting environmental and social challenges, it will take collective, not just individual action.

To be sure, serious impediments to solving environmental and social problems exist within science, society, and academia. I focus only on the latter. I posit that the biggest impediment within academia is its culture. Simply put, the culture of academia does not value or reward scientists who communicate with or engage with society. It rewards numbers of grants, numbers of publications, status of the journals, amount of money raised, and more recently, the quality of teaching. These are the currency of hiring and promotion.

I take heart from the fact that the academic culture is capable of evolving. Quality of teaching is now more routinely part of the hiring and advancement decisions than it used to be. I believe it is time for a second evolution, one that seeks to actively cultivate a culture of service to society through teaching, fundamental contributions to knowledge, and engagement with society focused on problem-solving. Promotion and tenure decisions should include the expectation of scientists doing outreach, communication and engagement. We need to train and empower our students to do the same. We need to give them the tools and resources to be today's and tomorrow's problem-solvers. And we need those students and scientists to reflect a greater diversity of society than is the case today.

In short, I suggest that we have made impressive progress in the last two decades, enabled by individual scientists taking individual action. But without collective action we will not deliver what society needs. What does collective action mean? To me it means confronting these cultural barriers and creating an opportunity for dialogue about engagement as a core responsibility for many faculty. I envision all faculty supporting the importance of engagement, and any faculty who wish to engage being rewarded for doing so. Secondly, collective action means changing the incentives—in job descriptions, promotion and tenure criteria, recognition, and awards. Thirdly, collective action means providing training, mentoring and the expectation of engagement for students. Training might focus on useful skills including communication and engagement, conflict resolution, negotiation, systems thinking, and teamwork—the kinds of skills that are required for successful engagement. Fourthly, collective action is needed to enable the partnerships that are needed for successful engagement. For example, a university or a group of faculty might want to partner with the local community, or with a non-governmental organization. That may require legal, intellectual property, and financial arrangements with which universities struggle. Fifth, collective action is needed to create communities of practice to sharing best practices and knowledge about successful engagement or scalable solutions. Finally, funding will be required to implement some of the above changes and enable effective engagement.

Many of the solutions to challenging environmental problems are inspiring. But we need more, and we need to scale them. We have seen what is possible when scientists are motivated. Now it the time to unleash more of that creativity.

In conclusion, I think we face a Moment of Truth. Those of you working on climate change are well aware of the magnitude of the challenges. So, too are those working on the loss of biodiversity or the disruption and depletion of ocean ecosystems. These and other problems will require herculean efforts on the part of scientists and society. Time is running out. This is an all-hands-on-deck moment. The past two decades have shown inspiring solutions that have

emerged from a subset of our community problem-solving and engaging despite the system. Just imagine what we could do if the system encouraged and enabled those approaches! It is time for a renewed social contract for science. It is time for the academic community to collectively make a quantum leap in our engagement with society. It is time for strategic, collective action to change the culture of academia, and mobilise enabling conditions for science to serve society more effectively. The question is 'Will you help make that happen?'

Q&A following Keynote Address:

Chris Rapley: Thanks Jane for a terrific talk. Your 1998 'social contract' paper' had an enormous impact. It inspired a lot of us to ask the questions 'What are we for, and what should we be doing—and are we doing it or not?' We felt that we were not. Since then, as you have pointed out, individual scientists have done a lot. But in some respects, much is the same. You particularly implored the scientific institutions to act. So what do you think the barriers have been to the large institutions? Because up until now we have not seen them shift in the way that we might have hoped.

JL: We have seen some action such as professional scientific societies being willing to make public statements, but we have not seen them change as much as is needed. Organisations like scientific societies respond to their members, so members have more power than they often think. One thing that would be useful would be to tackle some of the impediments to changing the culture of academia and of science. For example, some have suggested there is no good way to evaluate the calibre of scientific communication or engagement because we lack good metrics. There is a need therefore to give serious thought to the ways in which Promotion and Tenure committees might evaluate the quality of engagement or public communication. Another opportunity is to focus on what professional scientific societies could do to provide more compelling information to state legislatures, to governors, to members of Congress. Universities have opportunities as well. Some university Deans have enabled progressive, creative programs that engage students in problem-solving, create use-inspired science, and provide opportunities for training in engagement. Those could be praised and emulated. Simply taking stock of best practices could be useful.

CR: Reductionism is the only way you can really advance science. But you pay the price in that you create a multitude of silos. Specialist natural scientists find it hard enough to talk amongst themselves. But the social sciences, the science and technology studies, the neuroscientists, the researchers who understand values and how people make sense of the world—have generated a huge body of knowledge which would be helpful. Yet it is very hard to stitch that knowledge into the busy day of a natural scientist. Have you got any ideas on how we might get better at doing that?

JL: I believe that holistic approaches are a nice complement to reductionism. Understanding complexity is a case in point. The field of complex adaptive systems is providing a wealth of insights that are immediately relevant to understanding coupled human-natural systems. The emerging insights have yet to be applied to a plethora of social and environmental problems. How, for example, might one change the perverse incentives for actors in an environmental issue in ways that convert a vicious cycle into a virtuous cycle? i have seen impressive progress from much of the interdisciplinary science underway. I see productive collaborations, especially within bio-geophysical sciences, but more and more between bio-geophysical and socio-economic sciences. We have learned a lot about what works and what does not work, and that knowledge is proving useful.

CR: When we talk about the social contract with early career scientists they say 'We get this, of course we need to understand it'. So have you got any ideas on how we could take advantage of that natural enthusiasm we find in young scientists—who like to see that their work is actually being beneficial to society.

JL: Young scientists give me hope, because there is so much passion, curiosity, and willingness to jump in with both feet. What is lacking is often the enabling conditions for them—the tools, the funding, the training, the opportunities to engage and problem-solve. What we need to do is create the right environment for them to thrive, then get out of the way.

CR: What would be your final message? What is the one big thing that people should carry from this?

JL: Apart from my overarching message of the need for scientists to work together to enable science to be more useful to society, I'd like to mention the importance of thinking about incentives and ways to change them if they are not leading the desired outcomes. Incentives drive behaviour. It is worth asking what are the incentives for all relevant actors, from young people or faculty to deans? What are the incentives for leaders of scientific societies to lead

change? What are the incentives for our elected representatives, or natural resource users, or business leaders to do what they do? And if the outcomes are not in society's interests, how can those incentives be modified? If we can figure out what the perverse incentives are and how to remove those, and how we can change the system to reward the kind of behaviours that are going to bring collective good as well as individual good, then I think will be in a better place.

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