INTERFACES OF SCIENCE AND POLICY AND THE ROLE OF FOUNDATIONS

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CONFERENCE

INTERFACES OF SCIENCE AND POLICY AND THE ROLE OF FOUNDATIONS

16 AND 17 JUNE 2014
HUMBOLDT CARRÉ, BERLIN

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Visiting scholar, Stanford Center on Philanthropy and Civil Society (Stanford PACS), Stanford University, USA

Ehsan Masood
Editor in Chief, Research Fortnight, UK

Moderation
Björn Schwentker
Journalist, Germany

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James Wilsdon
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Moderation
Wolfgang Rohe
Executive Director, Stiftung Mercator, Germany

WOLFGANG ROHE
WELCOMING REMARKS

Wissenschaft und Politik sind zwei grundverschiedene Bereiche unserer Gesellschaft und sie folgen ganz verschiedenen Logiken. Und doch stehen sie vielfältig miteinander im Kontakt, ja es scheint so, als würden die Interaktionen nach Zahl und Intensität zunehmen. Wie ist es aktuell um das Verhältnis zwischen Wissenschaft und Politik bestellt? Was genau passiert an den sehr verschiedenen Schnittstellen, beispielsweise der öffentlich finanzierten Wissenschaftsförderung oder der wissenschaftlichen Politikberatung? Wo sind im internationalen Vergleich ähnliche, wo unterschiedliche Entwicklungen zu verzeichnen? Zur Beantwortung dieser und anderer Fragen hat die Stiftung Mercator gemeinsam mit ihren Partnern, dem Forum Internationale Wissenschaft der Universität Bonn, der Science Policy Research Unit der University of Sussex und dem Stanford Center on Philanthropy and Civil Society, die zweitägige Konferenz „Interfaces of Science and Policy and the Role of Foundations“ ausgerichtet.

Wir sind davon überzeugt, dass das vielschichtige Verhältnis von Wissenschaft und Politik in all seinen Dimensionen von zunehmender Bedeutung ist, weil beide Bereiche immer mehr aufeinander angewiesen sind. So benötigt die Wissenschaft allein schon für die Sicherung ihrer rechtlichen und finanziellen Rahmenbedingungen zwingend die Unterstützung durch die Politik. Angesichts der zunehmenden Komplexität fast aller politischer Handlungsfelder bedarf die Politik wiederum wissenschaftlicher Unterstützung und Beratung bei fast all ihren Entscheidungen. Die Handlungsfähigkeit moderner demokratischer Gesellschaften hängt somit auch immer stärker von der erfolgreichen Kooperation zwischen Wissenschaft und Politik ab.

Trotz oder auch wegen der engen Beziehung von Wissenschaft und Politik ist ihr Verhältnis nicht immer konfliktfrei. Häufig kontrovers diskutiert wird etwa die Reichweite der von der Wissenschaft beanspruchten Autonomie. Wissenschaft ist ihrem Selbstverständnis nach unabhängig in der Formulierung ihrer Erkenntnisinteressen und in der Wahl ihrer Methoden. Zugleich ist die Wissenschaft aber Teil der Gesellschaft und wird von ihr auch in der Erwartung finanziert, Leistungen für die Gesellschaft zu erbringen. Auch stellt die Wissenschaft solche Leistungen vielfach mit legitimatorischer Absicht in Aussicht. Wie können politisch formulierte Erwartungen mit dem Autonomieanspruch der Wissenschaft in Einklang gebracht werden? Diese und andere Fragen rund um das Verhältnis von Wissenschaft und Politik diskutierten Wissenschaftler und Leiter von Wissenschaftseinrichtungen aus Deutschland, Großbritannien, Neuseeland, den USA und der Schweiz mit einem internationalen Publikum.

“WE STRONGLY BELIEVE THAT THE COMPLEX RELATIONSHIP BETWEEN SCIENCE AND POLICY IS OF GROWING IMPORTANCE IN ALL OF ITS DIMENSIONS ON ACCOUNT OF THE FACT THAT BOTH SECTORS ARE INCREASINGLY RELIANT ON ONE ANOTHER.”

Science and policy are two fundamentally different domains in our society, each with their own distinct logical principles. And yet there is contact between them on a variety of levels; indeed it would appear that interaction increases according to the frequency and intensity of such contact. What is the current state of the relationship between science and policy? What precisely is happening at the very different interfaces – as regards public-sector funding of science, for instance, or in the area of scientific policy advice? If we compare Germany with other countries, where will we find similar developments, and where can different trends be observed? Seeking answers to these and other questions, Stiftung Mercator teamed up with the University of Bonn’s Forum Internationale Wissenschaft, the Science Policy Research Unit of the University of Sussex and the Stanford Center on Philanthropy and Civil Society to stage a two-day conference on “Interfaces of Science and Policy and the Role of Foundations”.

We strongly believe that the complex relationship between science and policy is of growing importance in all of its dimensions on account of the fact that both sectors are increasingly reliant on one another. Science, for example, is dependent on political support, if only to secure its legal and financial framework conditions. In view of the growing complexity of almost all fields of political action, policy in turn requires scientific support and advice in virtually all of its decision-making processes. To an ever greater extent, the ability of modern democratic societies to act therefore depends on successful cooperation between science and policy.

Despite or indeed because of the close links between science and policy, the relationship between the two is not always free from conflict. One frequent subject of controversial debate for example is the degree to which science can justifiably claim autonomy. Science perceives itself as being independent in the way it defines its fields of research and chooses its methods. At the same time, however, science is part of society, and is funded by society with an expectation that society will also receive benefits in return. Indeed science in many cases promises such benefits with a view to legitimizing its intentions. How can politically formulated expectations be reconciled with science’s claim to autonomy? Scientists and heads of scientific institutions from Germany, Great Britain, New Zealand, the USA and Switzerland joined an international audience in a discussion of these and other questions relating to the relationship between science and policy.

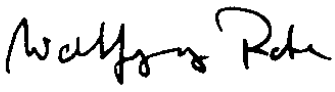
Mit der Konferenz war das Ziel verbunden, eine Diskussion anzustoßen, die letztlich dazu führen soll, dass neue, konstruktive Ideen zur Gestaltung des Verhältnisses von Wissenschaft und Politik entwickelt werden. Da es hierfür in verschiedenen Ländern unterschiedliche Lösungsansätze gibt, war es ein besonderes Anliegen, mit der Konferenz zur Intensivierung der länderübergreifenden Diskussion und einer Vernetzung wichtiger Akteure beizutragen.

Der Stiftung Mercator ist das Thema der Konferenz ein besonderes Anliegen – dies gilt auch für die kommenden Jahre. Warum? Die Stiftung Mercator versteht ihre Wissenschaftsförderung ausdrücklich als eine, die sie nicht allein um der wissenschaftlichen Erkenntnis willen betreibt. Die Stiftung hat vielmehr gesellschaftliche Ziele formuliert, zu deren Erreichung sie beitragen will. So gibt es unter unseren Projekten zahlreiche, die gleichzeitig wissenschaftliche und gesellschaftliche Ziele verfolgen. Wissenschaftliche Expertise und Ambition werden dabei mit öffentlicher politischer Kommunikation verbunden. So veröffentlicht beispielsweise das Mercator Research Institute on Global Commons and Climate Change (MCC) seine wissenschaftlichen Ergebnisse nicht nur in einschlägigen Fachjournalen. Es nutzt die Ergebnisse auch, um wissenschaftsbasierte Explorationen politischer Entscheidungsalternativen (sogenannte Assessments) zu erarbeiten, z. B. mögliche Handlungspfade für nachhaltiges Wirtschaftswachstum. Die Agora Energiewende hingegen bietet wichtigen energiepolitischen Akteuren aus Regierung, Wirtschaft, Zivilgesellschaft und Wissenschaft eine Plattform, um zu diskutieren, wie die Transformation des Stromsektors hin zu einem fast vollständig auf erneuerbaren Energien basierenden System gelingen kann. Und schließlich ist das Mercator Institute for China Studies ein Thinktank, der darauf abzielt, dass die Öffentlichkeit in Deutschland und auch deutsche politische Entscheidungsträger eine bessere Urteilsfähigkeit in chinabezogenen Fragestellungen erlangen.

Aufgrund dieses aktiven und diversen Engagements an der Schnittstelle von Wissenschaft und Politik ist es für uns als Stiftung von großer Bedeutung, unser Verhältnis zu beiden Systemen zu definieren und ein profundes Verständnis davon zu erlangen, welche Rolle Stiftungen wie wir an dieser Schnittstelle spielen können. Auch möchten wir wissen, wie wir zu einem verbesserten Verhältnis zwischen Wissenschaft und Politik beitragen können, was wir bei unserer Arbeit an der Schnittstelle beachten müssen und wo die Grenzen unseres Wirkens liegen.

Um diese Fragen beantworten und unsere Stiftungsziele erreichen zu können, müssen wir nicht nur über bestehende nationale und internationale Kooperationsformen von Wissenschaft und Politik informiert sein. Wir wollen auch das wissenschaftliche Wissen über die Schnittstellen von Wissenschaft und Politik erweitern und alle dafür relevanten Disziplinen nutzen. Dabei geht es immer auch um die Übertragbarkeit von Erkenntnissen auf unsere eigene praktische Arbeit. Die Konferenz hat hierzu wertvolle Beiträge geleistet, und sie stellt insofern den Auftakt für weitere Aktivitäten in diesem Bereich dar. Die vorliegende Dokumentation kann nicht im Einzelnen die komplexen Debatten auf den Diskussionspodien nachzeichnen, sondern soll einen Überblick über die diskutierten Themen bzw. Aspekte geben und damit weiterführende Diskussionen anregen.

Wolfgang Rohe
Geschäftsführer der Stiftung Mercator



Part of the reason for staging the conference was the desire to stimulate a discussion that would ultimately allow new and constructive ideas to be developed concerning how to shape the relationship between science and policy. Since different countries would come up with different possible solutions, one specific goal was for the conference to play its part in intensifying international discussion and interlinking key actors.

The subject of the conference has a particular resonance for Stiftung Mercator, and this will also remain the case in the coming years. Why? Stiftung Mercator explicitly regards its research funding as something that it pursues not solely for the sake of pure science. Instead, the foundation has defined societal goals which it wishes to help achieve. Among our projects, for example, are numerous initiatives which simultaneously pursue scientific and societal objectives. In this context, scientific expertise and ambition are combined with public political communication. The Mercator Research Institute on Global Commons and Climate Change (MCC) not only publishes its scientific findings in the relevant journals, for example, but also uses its assessments to explore alternative policy pathways on a scientific basis, e.g. possible courses of action aimed at achieving sustainable economic growth. The Agora Energiewende, on the other hand, provides leading energy policy actors in government, business, civil society and science with a platform upon which to discuss how to successfully transform the energy sector into a system based almost entirely on renewable energy sources. Last but not least, the Mercator Institute for China Studies is a think tank that wants to make the general public in Germany – and indeed German policy-makers – better able to judge questions and issues relating to China.

In view of our active and wide-ranging engagement at the interface of science and policy, it is of great importance to us as a foundation to define our relationship with both systems and to gain a profound understanding of the role which foundations can play at this interface. We also wish to know how we can contribute to improving the relationship between science and policy, what we need to take into account when working at the interface, and indeed where the limits to our activities lie.

If we are to find answers to these questions and achieve our foundation's objectives, we must be aware not only of existing forms of national and international cooperation between science and policy. We also want to expand scientific knowledge about the interfaces of science and policy through whichever disciplines will allow progress to be made. This also involves ensuring that our findings can be transferred and applied to our own practical activities. The conference has made a valuable contribution to achieving this, and as such marks the beginning of further activities in this area. This conference report cannot reproduce the complex debates that took place during the panel discussions in their entirety; its aim rather is to provide an overview of the subjects and aspects that were discussed and thus encourage further debate.

Wolfgang Rohe
Executive Director of Stiftung Mercator

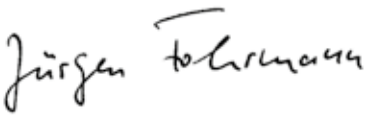
JÜRGEN FOHRMANN
WELCOMING REMARKS

Forschungen an der Schnittstelle zwischen Wissenschaft und Politik gehören zu den wirklichen Herausforderungen der Sozialwissenschaften. Denn dort, wo wissenschaftsgetriebene und politische Prozesse aufeinandertreffen, entsteht ein vielfältiges, nur schwer in einzelne Einflussgrößen zerlegbares und daher darstellbares Beziehungsgefüge. Die Forschungsprogramme und Netzwerke der einzelnen Wissenschaftler spielen hier eine ebenso große Rolle wie die je spezifische Funktionsweise von Scientific Communities, sind genauso bedeutsam wie interne universitäre Strukturen und wissenschaftspolitische Rahmensetzungen. Hierarchische und kollegiale Strukturen werden ständig miteinander verwoben. Weiter angereichert und zugleich bezogen wird dieses Gefüge durch und auf die Strategien anderer, das Feld berührender oder dem Feld nahe stehender Institutionen: etwa Förderorganisationen, nichtstaatliche, nationale wie internationale Akteure und außeruniversitäre Forschungseinrichtungen mit jeweils eigener Agenda. In ihrem Geflecht ergibt sich die Chance, mächtige Allianzen zur Förderung bestimmter Themen einzugehen und die Verfahren der Kooperation zugleich in Strukturen zu übersetzen, die auch die innere Organisation der Hochschulen entscheidend prägen. Die Schnittstelle zwischen Wissenschaft und so breit verstandener Politik wird dann zum *dritten Element*, das die Beziehungen innerhalb der Universität, die Verteilung von Ressourcen und die Reputation entscheidend beeinflusst. Dabei lassen sich die wechselseitigen Erwartungen der unterschiedlichen Akteure in keiner Weise einfach aufeinander abbilden. Dies gilt auch für die Erwartungen, die Stiftungen an die Wissenschaft herantragen (und vice versa). Und dies gilt auch in besonderer Weise für wissenschaftspolitische Setzungen, die auf die Ziele und Verfahrensweisen der Universitäten und auch der außeruniversitären Forschungseinrichtungen nicht abbildbar sind.

Die Publikation dokumentiert eine Konferenz, die die vielgestaltige Rolle solcher Schnittstellen im Spannungsfeld von Kooperation und Wettbewerb untersucht, sich mit den wechselseitigen Adressierungen auseinandergesetzt und ihre Effekte im politischen Raum beobachtet hat.

Ich danke der Stiftung Mercator für die perfekte Organisation, die umfassende Unterstützung und die freundliche Kooperationsatmosphäre, die zwischen den vier Partnern herrschte.

Jürgen Fohrmann
Rektor der Universität Bonn



"RESEARCH ON THE INTERFACE BETWEEN SCIENCE AND POLICY IS ONE OF THE MOST DEMANDING TOPICS IN THE FIELD OF SOCIAL STUDIES."

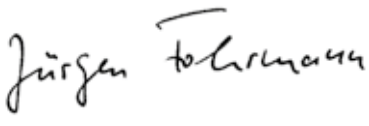
Research on the interface between science and policy is one of the most demanding topics in the field of social studies. It deals with a field which is science-driven and political at the same time. And it is a topic with a multiplicity of relations. It takes into consideration the relationship between the programmes of single researchers, their communities or the internal structures of universities as part of the global research network on several levels. Vertical and non-vertical structures are in a constant state of interaction. The result is an interface which tends to be identical with the interacting institutions themselves. Furthermore, it sees policy as well as the politics of other units, for example the strategies of third-party funding organizations, federal and non-governmental institutions and non-university research groups which have their own agenda. This agenda may concern the legal conditions, the financial and human resources, and the chance of building mighty alliances for the promotion of topics, to name only a few aspects. From the perspective of universities these agenda are either frames for action or complementary resources, either partners in an alliance or structural models which should be copied into the university's programme. In all cases this interface is *the third element* which organizes the relation between the institutional levels of the university itself. In this respect it has an important impact.

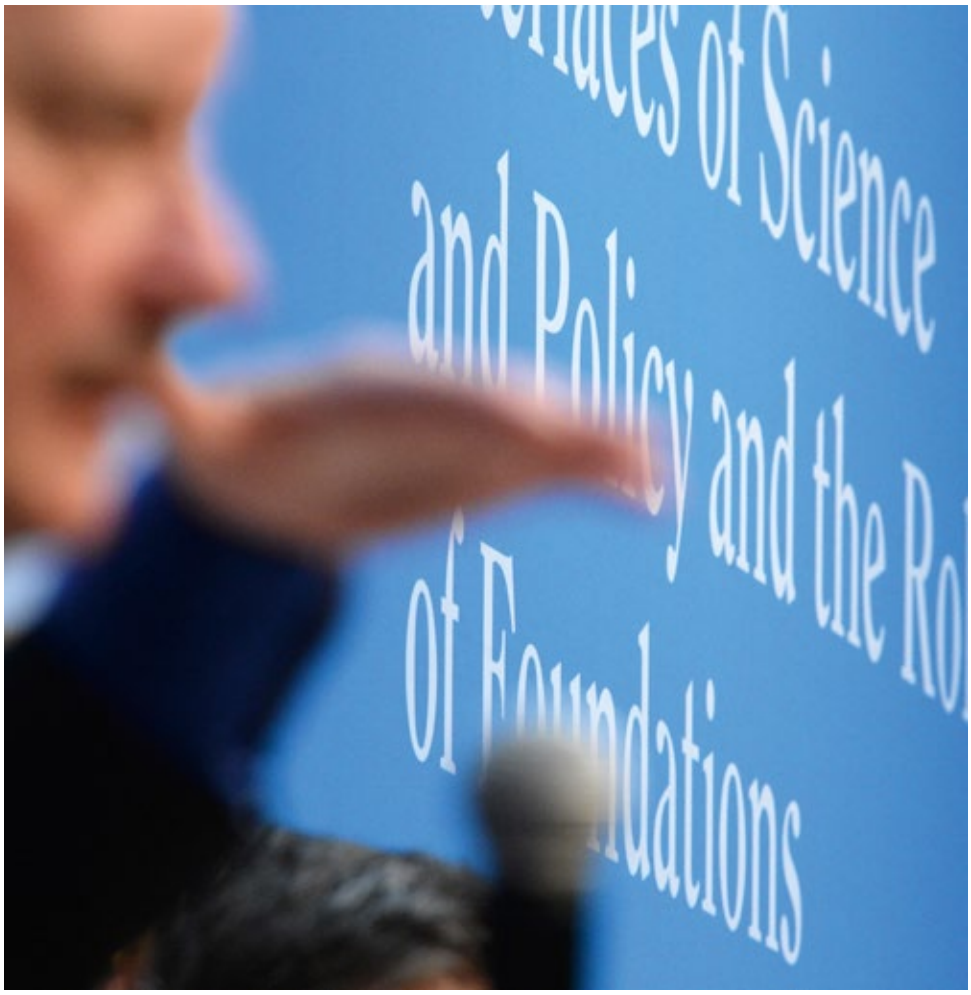
This does not mean that this impact is identical with the expectations of the foundations which are driven by their own agenda. There is no one-to-one relationship because every institution is ruled by its own mission and programme. This is why the agenda-setting of politicians usually has an incalculable or low impact if it is not applicable to the goals of university – and this is, by the way, not so clear for non-university research institutions.

This publication documents a conference which has asked for the modes of interface, of cooperation and competition. And it has dealt with the expectations of each institution in its agency towards another unit and the results of the mutual impacts.

I have to thank Stiftung Mercator for the perfect organization, the great support und the friendly atmosphere of cooperation between the four partners.

Jürgen Fohrmann
Rector of Bonn University




and Policy and the
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Policy
16 and 17 June 2014
Interfaces of Science
and Policy and the Role
of Foundations

OTTMAR EDENHOFER
CARTOGRAPHY OF POLICY PATHS: A NEW ROLE FOR SCIENCE IN POLICY[1]

Dear Mr Rohe, dear colleagues and friends, thank you very much. It is a great honour and pleasure for me to be here and have the opportunity to talk to you about the science-policy interface. I will not be talking about the science-policy interface merely in general terms, as I have a very specific topic in mind, one which I like to call the art of assessment-making. It seems to me that assessment-making is a very important and very special way of establishing a science-policy interface. Since 2008, I have held a leading position within the Intergovernmental Panel on Climate Change, the IPCC. As I am now trying to gain some distance from this experience, I would like to take this opportunity to reflect on this experience. What I want to make clear is that what I will say to you today should not be attributed to the IPCC. Rather, what follows are my own opinions, as I will be talking to you as a "free man".

The value and challenges of scientific assessments

Scientific assessments are a very special form of engagement in the science-policy interface because they allow for a highly formalized, systematic and comprehensive synthesis of knowledge that aims to explain the available options to policy-makers and other decision-makers. It is worth undertaking such a mammoth task when huge and complex societal challenges need to be addressed. Such societal challenges are typically associated with high levels of uncertainty and conflicting values. In many cases, assessments have given rise to a better awareness and understanding of the problem. There were, however, also quite a few assessments of potential policy solutions carried out over the past decades, one example being the "Mirrlees Review", which involved public finance experts attempting to design an optimal tax policy for the UK and, potentially, other countries too. The 'Global Energy Assessment' is an example from within the UN system; it sought to identify the best means of reconciling energy security, global change and the climate change issue within one particular perspective. The 'Economics of Ecosystems and Biodiversity' was yet another exercise that aimed to synthesize scientific knowledge relating to a specific subject, including policy analysis – as is the most recent IPCC report on climate change physics, impacts, adaptation and mitigation options, which took some seven years to compile – with a view to better informing policy-makers and government representatives in the UN system.

So why does the particular challenge posed by climate change require such large-scale assessment? Martin Weitzman recently highlighted this problem in a lecture he gave at the Mercator Research Institute on Global Commons and Climate Change. He referred to climate

change as "the problem from hell," in the sense that it requires risks to be taken into account that are not merely large-scale in terms of space, time and dimension, but are also perhaps irreversible. The probability of such risks occurring may be low, yet their potential impact is very high. Although nobody can precisely predict this probability, what we do know is that unmitigated climate change can lead to irreversible, adverse changes in the earth's system. This aspect is perhaps unique, as we have never before faced such potential consequences. When we talk about climate change, we additionally need to consider and explore the ethical dimension of the problem, particularly taking into account not only the global scale but also inter-generational issues such as justice and fairness. In other words, it is not just about the facts; it is also about values. Since we are looking at a global common-pool resource problem, this also means that we need to think about global cooperation and coordination. This makes the problem even more daunting, because achieving this is problematic not only with respect to the issue of climate change but in many other areas, too.

The IPCC was set up as an institutional response to this 'problem from hell', and I have also had some rather frustrating experiences over the last few years. Many of the scientists working for the IPCC, on the other hand, felt that this was quite an exciting challenge, some claiming that it was the most influential and rewarding experience of their professional lives.

The thing to understand about the IPCC assessment process is that it is highly complex and extremely laborious. It is also important to be aware that we have two fundamental milestones in the IPCC process. The first requires governments to agree on the outline of the report, which means that its structure is defined from the outset and cannot subsequently be changed by the scientists. Once this had been achieved, however, governments granted us complete freedom to compile the report as we saw fit, without intervening in the process at all. Although they provided us with a number of comments and some advice, we scientists ultimately had full autonomy and control over the content of the chapters, the Summary for Policymakers and the Technical Summary of the IPCC report. Once the report had been completed and submitted to the national governments, we reached the second milestone when we held the approval session in Berlin in early April 2014. This session involved government representatives and scientists revising and agreeing on the text of the Summary for Policymakers, line by line. You may have heard in the media that the governments insisted on deleting certain parts of the draft Summary for

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Ottmar Edenhofer

Policymakers because they were not entirely happy about what we wished to communicate to them. However, what is important to understand is that there are three layers to the final report. The first is the Summary for Policymakers, which reflects the consensus negotiated between the governments and the contributing scientists. The second level is the Technical Summary that sets out the consensus actually reached by the scientists among themselves, this being what they wished to communicate to the governments. Finally, the underlying report aims to provide a detailed account of the current status of the peer-reviewed literature. One of the core problems at the science-policy interface is that we have to deal with the reality that facts and values are highly intertwined in scientific studies, which also explains this layering of the IPCC report.

How to be policy-relevant but not prescriptive? The cartography of policy pathways

The crucial question for any assessment, and this holds particularly true for the assessments of the IPCC, is how to be policy-relevant and credible without being policy-prescriptive. Any response to this question has to make assumptions about the relationship between facts and values in science. Essentially, there are two fundamental approaches which are usually employed at science-policy interfaces. The first of these 'models', as I would like to call them, is known as the technocratic model, while the second is the decisionist model. The technocratic model is very simple: it is based on the idea that scientists can and should communicate the truth to those in power. In this model, science is perceived as a kind of truth-telling machine, scientists being the ones who define and explore policy objectives and the necessary policy means in a non-value-based manner, whereas policy-makers simply have the task of implementing what science tells them to. It is obvious that this is not a particularly convincing model. Nevertheless, I can assure you that many scientists have this model firmly in their minds. The decisionist model, on the other hand, acknowledges that scientists frequently have to make disputed value judgements when formulating policy objectives. They are therefore not entitled to define appropriate societal goals. Rather, and this is what Max Weber would call "ends-means rationality," their task is simply to identify the most efficient means of achieving a policy objective previously defined by policy-makers and citizens.

However, this model is not appropriate either, because there is no way when evaluating policy options in practice of clearly separating policy objectives from the means by which to achieve them. Let me give you just one example. You might conclude that large-scale deployment of bio energy might be required to achieve a low CO_2 stabilization level and thus mitigate climate change. Although this may sound like a good idea, the increased production of bio energy could potentially have a negative impact on biodiversity or food security. If such side-effects turn out to undermine the desirability of reducing CO_2 levels or achieving other important societal goals, you will need to consider revaluating your means or possibly even your objective. The decisionist approach does not work because it is based on the misconception that policy objectives and means can be developed and evaluated separately.

Instead, I prefer a model which is based on John Dewey's pragmatist philosophy and which we have tried to implement in the form of Working Group III's contribution to the IPCC's Fifth Assessment Report. I am not claiming or arguing that we have been entirely successful, but we did at least attempt to establish a basis for it. In this model, known as the pragmatic-enlightened model[2], the scientist's role is more that of a map-maker who is attempting to explore different policy objectives and the various pathways that lead to them. Consequently, scientific experts have to explore the underlying costs and risks of these pathways, as well as the opportunities each presents. Furthermore, they have to be explicit about and communicate the uncertainties that lie along each pathway.

The pragmatic-enlightened model in practice: experiences of the IPCC Working Group III

Allow me to highlight some examples from our work at the IPCC that will clarify what I mean. I am confident that these examples will help you better understand the nature of the opportunities and problems we are dealing with in large-scale scientific assessments. I will start with a positive example. I would like to argue that the IPCC has been successful in exploring future pathways. We mapped out different emission pathways which are consistent with different goals, or at least with different outcomes. The baseline CO_2 emission scenario, which assumes a temperature increase on the current trajectory, gives rise to an increase in global mean temperature of about

five degrees Celsius by the end of the 21st century. Many people argue that this is without doubt a devastatingly high level of climate change, but that is not important for my argument right now. We considered two alternative scenarios, both based on lower levels of CO_2 emissions – one which would lead to a three-degree increase and one which is consistent with the much-discussed two-degree goal. Now, we do not argue in our report that the two-degree goal is preferable. Nor do we argue that a three-degree goal is the way forward. Instead, we merely sought to set out the underlying costs and the underlying technological and institutional implications of both policy goals. We wanted to convey that there are many pathways by which to achieve either of these goals and that both goals have specific implications. Specifically, what we wished to communicate to policy-makers is that, were they to choose the goal of stabilizing the global temperature at a level of two degrees of warming, the first step would be to significantly reduce greenhouse gas emissions, something which could be achieved by dramatically upscaling low-carbon technologies, though this also entails certain risks.

Many policy-makers and negotiators argued that the two-degree goal is not at all realistic because they do not believe that it will be possible to reach any comprehensive and successful international agreement at the 2015 UN climate summit in Paris as planned. We then wondered whether it would still be possible to meet the two-degree goal if there were a delay in international coordination and cooperation, and considered the possible implications of such a delay. We came to the conclusion that a delay could be accommodated, but that this would necessitate much more ambitious emission reduction targets and much more ambitious upscaling of low-carbon technologies after 2030. This is how we attempt to facilitate debate between scientific experts and policy-makers: by showing policy-makers what they have to do and take into account if they wish to achieve a two-degree goal despite being pessimistic about the prospects of future negotiations. Our impression was that this kind of analysis was very much appreciated.

Now I would like to give you other examples[3] which I consider to be fairly enlightening – at least for me they were – as regards the problems related to the entanglement of facts and values. Contrary to the positive feedback

"GOVERNMENTS OFTEN FEEL VERY UNCOMFORTABLE WHEN SCIENTIFIC EXPERTS CONFRONT THEM WITH EVALUATIONS OF HOW THEIR POLICIES PERFORMED IN THE PAST."

Ottmar Edenhofer

we received about our approach to future scenarios, we encountered substantial problems when we attempted a retrospective, ex-post evaluation. During the approval session for the Summary for Policymakers, we found that governments are far less appreciative when confronted with an analysis and comparison of their past emissions and with an assessment of the outcome of their national or regional policy choices. For instance, we compiled a graph that showed the cumulative emissions since the beginning of industrialization; it clearly demonstrated that more than half of the cumulated emissions have occurred in the last four decades. It also provided a breakdown of contributions by geographical region. Without going into too much detail, it became clear that some countries did not share our interest in illustrating the historical development of emissions in this way. Why? Because they saw a direct link between this presentation of historical facts and the debate surrounding historical responsibility, which is an important factor in climate negotiations. In the end, governments removed this graph from the Summary for Policymakers.

Another graph with a retrospective analysis that we chose for the Summary likewise caused problems. It simply compared past emissions of country groups with different income levels. The low income group increased their emissions due to deforestation, while the middle income countries are tending to replicate the economic and industrial history of the high income countries. Basically, the graph that was ultimately deleted from the Summary argued that there is no leapfrogging in history that would have allowed countries to become wealthy without the massive use of fossil fuels. However, the upper middle income countries and in particular the lower middle income countries felt very uncomfortable about such an analysis of emission trends and the related income-based country grouping because they were afraid of the potential implications this might have for international climate policy negotiations. Some of these middle income countries are currently regarded as developing countries in climate policy negotiations, which implies some benefits for them in terms of international burden sharing; they evidently assumed that such an analysis could perhaps pave the way for a different and far less beneficial country grouping in international climate policy negotiations – based on the insight that middle income countries basically follow the same adverse emission path as developed countries did.

“WE MUST TRAIN SCIENTISTS TO CARRY OUT BOTH EX-POST AND EX-ANTE ASSESSMENTS APPROPRIATELY AND ON THE BASIS OF SERIOUS INTERDISCIPLINARY COOPERATION.”

Ottmar Edenhofer

I could also tell you about the unwanted ex-post evaluation of the European emissions trading scheme in the IPCC in terms of the problematic way in which feed-in tariffs interact with emissions trading, and provide you with many more examples besides. To conclude, governments often feel very uncomfortable when scientific experts confront them with evaluations of how their policies performed in the past.

Research gaps, challenges and tasks for science foundations

Let me say a few things about the challenges that lie ahead when it comes to implementing the pragmatic enlightened model of expertise in policy. First of all, although many attempts to replicate the general IPCC model of credible and policy-relevant large-scale assessment-making can be observed, there are certain fundamental issues that need to be improved. The first is that policy-makers have to learn how to use and appreciate the knowledge maps developed during the course of such assessments; specifically, they need to understand that it is in their best interests to learn from ex-post policy analysis. On the other hand, scientific experts also have to become more aware of the political and ethical implications of their research. It is important to conduct ex-post policy evaluation

according to varying evaluation criteria and political value systems, as was attempted to some extent in the IPCC Working Group III. In my opinion, we also need to improve assessment methodology. For instance, we must train scientists to carry out both ex-post and ex-ante assessments appropriately and on the basis of serious interdisciplinary cooperation. Unfortunately, this kind of scientific exercise is not something that is typically found as yet in Science, Nature or any other leading academic journal, despite the fact that assessment-making of this kind should be regarded as a scientific art in its own right and with its own value. Moreover, we should reduce the complexity of the material assessment needs to synthesize by carrying out pre-studies and pre-assessments which help us better understand specific aspects of ex-ante and ex-post policy assessments. There is still a lack of literature, for example about what national, sub-national and city-level policy-makers really can do and what they need to consider.

I would argue that the art of assessment-making can be improved considerably with the help of a science foundation like Stiftung Mercator: such foundations can provide an incentive for systematic, applied and trans-disciplinary research while at the same time helping to promote the acceptance of assessment-making as scientific activity and respected work in its own right. They can also help to change the image of assessment-making, for example by supporting the recruitment of bright young women so that it is no longer perceived merely as something done by old male professors. In addition, it is also important for funding to be made available for more meta-research into how to improve the assessment processes and methodologies.

The popular Mercator world map from 1569, though still very rough and mistaken in some details, provided much better orientation for navigators than previous maps such as the Ptolemy world map from 1482. This improvement can serve as a useful metaphor for scientific experts ideally playing a role as map-makers in accordance with the pragmatic-enlightened model. Scientific assessments should seek to better inform policy-makers – the navigators in our example – by providing them with maps of knowledge that shed greater light on the implications of alternative, viable policy pathways, even if much of this knowledge may remain uncertain and approximate. If this vision is to be realized, scientific experts and policy-makers alike need to be very open-minded when it comes to learning about the options available.

Ultimately, I believe that this kind of assessment-making is not merely a technical exercise. It is not only about information or about bringing scientific findings to the table. We also need to ask ourselves some very fundamental questions about our values and worldviews as scientists. We need to consider our own personal identity – who am I? And indeed explore our individual and collective societal identities – who are we? I would therefore argue that there are many fundamental ethical questions at the core of the science-policy interface, so it should be designed in a way that enables the public not only to understand the options we are mapping out for them, but also to choose the pathways which are consistent with our personal and collective identities. Thank you very much.

[1] In collaboration with Martin Kowarsch and Christian Flachsland.

[2] For a description of this model, see O. Edenhofer and M. Kowarsch (equal contributions), 2014. Cartography of policy paths: A model for solution-oriented environmental assessments. MCC Working Paper. Online: http://www.mcc-berlin.net/fileadmin/data/pdf/Publikationen/Edenhofer-Kowarsch_PEM_article.pdf.

[3] For more detail, see O. Edenhofer, J. Minx, 2014. Mapmakers and navigators, facts and values. Perspectives. Science 345 (6192), 37f.

LECTURE

SIR PETER GLUCKMAN
ANALYSING LINKAGES BETWEEN SCIENCE AND POLITICS

I want to thank the Foundation for providing a forum to bring practitioners of science advice and academics in STS together. My own role is somewhat unusual as I think I am the only speaker who has a formal role on both of the two quite distinct dimensions of this – enhancing the use of evidence in policy as a whole and the more traditional issue of policy development for the science system.

There have been dramatic changes in science in recent decades and these changes have implications in considering the nexus between science, policy and politics.

Until recently, science and especially technology largely addressed apparently linear questions, but in the last decades, fuelled by the shift to multi-disciplinarity, increased computational power and the explosion of biological, environmental and social sciences, science has increasingly focused on complex, nested and nonlinear systems. Thus much science is no longer about seeking precision but about understanding probabilities.

Inevitably, it is the questions that are the most complex for which the public has high expectations of solutions from their elected governments. Indeed, to use the terminology of 'post-normal science', while the issues are urgent and science has added considerable knowledge, it has also highlighted many unknowns and uncertainties. In such science, there will inevitably be an inferential gap between the science and conclusions drawn. There is almost always a high values component and high public and political interest in these issues that lie at the science policy interface.

There is an inherent tension between the world of science that claims relative objectivity and, at least in its processes, to be as values-free as possible, and the values-laden policy and political worlds. But it is the latter that is ultimately charged with integrating scientific 'evidence' with many values-based inputs into policy development. These include public opinion, social licence, the electoral contract and ideologies, fiscal priorities, and so forth.

And so we have the challenge that is the focus of this meeting: we need to be generating quality science to help address those post-normal questions. And we need to be mobilizing that knowledge – brokering it through policy development – to our social, environmental and economic advantage. It sounds straightforward, but in reality, both elements of that challenge are anything but. And there is a complex interplay between these two somewhat distinctive elements: science advice for public

policy and policy advice for enhancing the science system. We all appreciate that science and technology are at the heart of most of society's most pressing problems – as potential solutions, but also sometimes as a cause. In all of these, the potential contribution of many sciences, including the social sciences, is unequivocal, but just as important will be the role of social licence for determining the use of new technologies and the application of new knowledge.

While science is a set of relatively formal processes that is ultimately the only way we have to develop relatively reliable information about ourselves and our world, social licence is the product of the processes of public reason that vary across nations: these processes are changing rapidly with the emergence of Twitter and the blogosphere. The perception of risk and trade-offs differs markedly between science and the processes of public reason; yet both must be integrated into the policy-making.

There are many examples but I will simply give two from opposite ends of the political spectrum. Firstly, consider the continued framing of the GM food controversy as a scientific issue of food safety when the underlying debates are essentially philosophical about perceptions of what is natural or unnatural or are ideological, reflecting conflicting views on the role of multinational organizations. Both may be valid societal debates but they are not scientific. A second example is the exploitation of scientific complexity in climate change modelling to obfuscate what is essentially a values debate about inter generational economic equity: this could well create a tragedy of the global commons. In my view the core issue in both has been the inability to separate what is science from what are values–based issues. The former is the role of the scientific system; the latter is the domain of the politician. The inability of the societal debate to separate the two demonstrates the extent of complexity at the crossroads for science and politics.

The integration of scientific evidence into policy, and indeed politics, can be corrupted by advocacy manifesting as science or scientists not distinguishing between knowledge brokerage and values-based advocacy. Equally there can be hubris on the part of the politician or the policy-maker who assumes that science can be ignored, over-simplified, or that it is not to be trusted because it might conflict with ideological policy positions. Hence the emergence of the knowledge-broker who must first distinguish between these two domains, and then bridge them. The advisory requirements for evidence-informed policy development and for developing policy for science

are themselves distinct. However, these are often within the remit of the same science advisor or advisory committee. If science is to constructively influence public policy formation there are a number of base conditions that need to be met.

First is to understand that science is more likely to be respected by policy-makers when its limits and positioning within the policy processes are understood. This means accepting that science alone does not make policy; all it can do is inform policy and it should do so iteratively throughout the policy process. It is how that is done that is at the core of a national science advisory system.

Second, that we are having this discussion at all suggests that science has some privilege in the policy process. This arises because science has a set of recognized processes that distinguishes it from other sources of knowledge such as those that may be based on tradition, belief, dogma or anecdote. So this is what gives science a privileged claim to knowledge, but its privileged place in policy development is based ultimately on trust, and that trust depends on the way science is conducted, provided and explained. This privileged place is fragile and depends on not overstating what is known and on acknowledging the limits of science.

It is this concept of trust that is the third condition of effective science advising. The science advisor, be it an individual or a committee, must sustain the trust of multiple stakeholders – the government, the policy-maker, the media and public and the scientific community. The latter can be the most difficult, particularly if they assume that the primary role of the science advisor is to lobby on their behalf.

As an over-simplification, maintaining trust also implies a separation and independence from the political process if the role is to stay focused on knowledge brokerage. Once it crosses extensively into the values and political space, trust is easily lost. An effective science advisor cannot be the expert on everything – indeed that is not their role. Rather they must know how to reach out to the science community for relevant expertise and, importantly, they must also be able to reach into the policy space to ensure receptivity. Thus a direct link to the office of the chief executive becomes invaluable, and this is my fourth base condition: effective access to the executive, but relative independence from it.

"THE INTEGRATION OF SCIENTIFIC EVIDENCE INTO POLICY, AND INDEED POLITICS, CAN BE CORRUPTED BY ADVOCACY MANIFESTING AS SCIENCE OR SCIENTISTS NOT DISTINGUISHING BETWEEN KNOWLEDGE BROKERAGE AND VALUES BASED ADVOCACY."

Sir Peter Gluckman

NZ is somewhat unusual in the way it has constructed the role of CSA, a position that is only five years old. While I directly report to the Prime Minister, my constitutional and academic independence is protected by setting up my appointment as a committee (albeit of one member) rather than as a civil servant or member of the Prime Minister's staff. But there remain implied limits on how one acts because of the need to maintain trust and hence the need for other forms of input such as national academies and think tanks.

Let me now turn to the question of models for science advice, particularly for enhancing the use of robust evidence in policy development. There is no single approach and the model chosen by a given jurisdiction depends greatly on context, including the shape and maturity of the science system itself; the political structures; the processes of public reason; and ultimately, the general level of science capital – that is how society as a whole perceives the importance and role of science.

The effectiveness of any model depends on the principles we discussed earlier and, in particular, on giving confidence to the policy-maker that science advice is focused on what is known and not known and the options that thus arise, and does not usurp decisions over values dimensions and the ensuing trade-offs which are properly the domain of the policy-maker and the politician. There may be no way to stop politicians cherry-picking science, but we need to stop that happening during policy creation and must not let science be used as a proxy for other debates. Honest brokers within a robust science advisory model can try and bring the discussion back to a more constructive level.

Because evidence is increasingly accepted as the key to effective policy-making across all domains of government, particularly in the most complex and contentious issues that cross portfolios, governments need their most senior scientific voice to have ready access to the chief executive. Policies, processes and protocols need to exist across government to ensure the identification and use of robust evidence, which the science advisory system should develop and monitor. In Britain this has now extended into a system that includes not or a chief CSA but also departmental CSAs who have many analogous responsibilities. In NZ we have moved in the same direction following a review I conducted of departmental attitudes to science in the policy process – a review with some very mixed findings. As a result, we have appointed or are appointing several departmental science advisors to assist the policy process within departments and the network which I chair will, as it develops, become an important resource for breaking down departmental silos.

An increasing number of countries have CSAs and Europe is joining this trend, others have formal advisory panels (although these tend to focus on policy advice for the science system) and yet others turn to their national academies. All have a potential role and they are not mutually exclusive. But particularly in terms of science advice for public policy formation my bias is towards an individual CSA. Committees can have their own dynamics and may not have the level of access to deal with emergent and acute issues. The role is tough and requires simultaneously sustaining trust of the government executive, the policy community, the science community and the public. Certainly the role of a science

advisor is made easier if it goes hand in hand with a strong scientific academy to assist or address issues of a chronic nature with authority.

Until now, I have been addressing the issue of science for public policy. But let me now say something about policy for enhancing science and innovation, which has been the usual focus of discussion. In general most countries have fairly established policy processes and levers for their science systems and these are largely driven through ministries of industry, science and innovation or higher education (as the case may be), supported by a variety of inputs.

But the nature and role of public science is evolving and science-funding systems need to evolve. Issues that are emerging include the potential breakdown of the classic peer review system, unanticipated consequences of the move to open publication, and the move to more private sector engagement with public science. Thus broader inputs are needed and different countries have adopted different structures to do that – often with the use of high-level panels that may or may not involve the tertiary education sector and the private sector. The science system is NOT just like any other programme administered by government; deep expert policy advice from active scientists on how science works is essential. I think similar principles, as I described earlier, still apply. But here the science advisor or panel is effectively advocating for what science can do to advance national interests. Thus the advisor is facing a delicate path of advising on the development of the science system, which does need specialist and expert input, while facing sceptical policy-makers who may see the arguments as nothing more than lobbying. The key in my mind is to understand the inevitability of this perception and thus ensure the focus is on the many ways science impacts on national objectives.

I say this because another important shift that is occurring is that publically funded science is now considered in a much more utilitarian way than in the past. Once, public science was expected to generate new knowledge largely in isolation from the processes that might mobilize and apply that knowledge. This is no longer the case. The contemporary turn of public science towards "relevant research with impact" has many implications, and these are especially intense in small science systems like my own (but also seen in the Horizon 2020 programme). For instance, there is greater prioritization happening and in turn this has implications for structuring science systems to protect some of the core needs.

"INCREASINGLY THERE IS A CRITICAL ROLE FOR THE MULTIPLE ACTORS WITHIN A SOCIETY TO HELP SHAPE WHAT A SCIENCE SYSTEM DOES AND WHAT PURPOSES IT CAN SERVE."

Sir Peter Gluckman

This shift in turn reflects a changing compact between science and society. Increasingly there is a critical role for the multiple actors within a society to help shape what a science system does and what purposes it can serve. There is now a broad recognition of the need for the science system to better justify itself and to demonstrate impact beyond the academic and incorrect meaning of the word.

This shift is already creating tensions. However, the utilitarian argument is not, as many perceive it, an argument between basic and applied research. Rather it is about ensuring that the ultimate funders understand the purpose of their investments across the whole ecosystem. And this must include both discovery science, which ultimately drives innovation, and mission-led science, which is designed to answer fairly specific questions for end-users.

For their part, active scientists wishing to have impact on society through their science must tell their stories better. But in doing so I would hope they would better appreciate that credibility is at risk if their claims to special expertise are used to extrapolate beyond their science – unless their role as interested lobbyists rather than as knowledge brokers is made clear. Otherwise trust in the entire scientific endeavour may be undermined.

Scientists in publically recognized roles such as my own are in a more difficult position: we must distinguish between knowledge brokerage and advocacy but, in the performance of that role, we necessarily must advocate and show how science can indeed enhance the processes of policy formation and how enhancing science can advance a nation. This is indeed a delicate position. Society's knowledge needs are too great, and there is too much at stake, to get it wrong.

I look forward to the discussion over the next two days as I see this as part of a growing global dialogue. Indeed, in August this year in Auckland there will be the first global meeting on the issue of high level science advice to governments. Over 40 countries will be represented and the meeting is open to academics and practitioners alike. Details are at www.globalscienceadvice.org. Thank you.


Science


Policy
16 and 17 June 2014
Interfaces of Science
and Policy and the Role

SCIENTIFIC ADVICE: APPROACHES AND LIMITATIONS – INSIGHTS FOR THE GERMAN SYSTEM

Wissenschaftliche Beratung bildet eine Brücke zwischen Wissenschaft und Politik. Sie nimmt dabei sehr unterschiedliche Formen an und reicht von der Beantwortung expliziter Fragen der Politik über seitens der Wissenschaft aktiv angebotener Themen- und Handlungsanalysen bis hin zu Formen des Lobbyismus. Das Panel nahm unterschiedliche Modelle mit ihren jeweiligen Vor- und Nachteilen in den Blick, wobei unter den Diskutanten Einigkeit darüber herrschte, dass die kulturellen Unterschiede in den nationalen Wissenschaftssystemen analysiert und anerkannt werden müssen, damit wissenschaftliche Politikberatung weiterentwickelt werden kann.

Die Wissenschaft steht dennoch in vielen Ländern vor ähnlichen Herausforderungen, wenn es darum geht, wissenschaftliche Erkenntnisse im politischen Prozess wirksam werden zu lassen. Entscheidend für den Erfolg wissenschaftlicher Beratung ist unter anderem, dass es der Wissenschaft gelingt, das in sie gesetzte Vertrauen zu erhalten bzw. wiederzuerlangen. Dafür muss die Wissenschaft deutlich machen, dass sie keine „truth-telling machine“ (Edenhofer) ist, sondern dass auch wissenschaftlicher Forschung stets epistemologische Grundannahmen und/oder ethische Werte zugrunde liegen. Für eine stärkere Berücksichtigung wissenschaftlicher Erkenntnisse in der politischen Meinungsbildung und Entscheidungsfindung ist daher auch ein gewisser Wandel im Selbstverständnis der Wissenschaft notwendig. So sollte in der wissenschaftlichen Beratung nicht länger nur die eine wahre Auskunft angestrebt, sondern sollten alternative Handlungspfade aufgezeigt werden.

Auch dem gemeinnützigen Sektor kommt eine gewisse Rolle in der Politikberatung zu: Er kann einerseits der Politik durch Thinktanks selbst wissenschaftliche Erkenntnisse liefern und damit auch eigene politische Ziele verfolgen. So können Fragen adressiert werden, die die Politik bisweilen so nicht gestellt hat und die Bandbreite an Themen auf der politischen Tagesordnung erweitert werden. Der gemeinnützige Sektor kann andererseits durch die Wissenschaftsförderung die Exploration alternativer Handlungspfade für die Politik wahrscheinlicher machen. Immer bleibt es eine Herausforderung, tatsächlich Eingang in den politischen Prozess zu erlangen.

Scientific advice bridges the gap between science and policy. It can take many different forms: providing politicians with answers to explicit questions, presenting thematic and action analyses actively offered by science, or pursuing forms of lobbyism. The extent to which it is organized and institutionally anchored varies considerably from one country to another. The panel explored different models with their respective advantages and disadvantages, participants generally agreeing that the cultural differences between the national science systems need to be analysed and acknowledged if scientific policy advice is to be further advanced.

Nonetheless, science faces similar challenges in many countries when it comes to ensuring that scientific findings are able to exert impact within the political process. Successful scientific advice relies among other things on science being able to maintain or regain the trust placed in it. To this end, science must make it clear that it is not a “truth-telling machine” (Edenhofer) but that scientific research is also based always on fundamental epistemological assumptions and/or ethical values. If greater consideration is to be given to scientific findings in the processes of political opinion-forming and decision-making, a certain shift in the way science perceives itself is thus also necessary. The discussion participants felt for example that scientific advice should no longer strive to find only the one true outcome, as has often been the case in the past. Instead, alternative courses of action should be highlighted.

The non-profit sector also has a certain role to play in political advice: through think tanks, it can itself supply politicians with scientific findings on the one hand, and thus pursue its own political objectives. Thus questions can be addressed which have not been raised in this manner by politicians, and the spectrum of issues on the political agenda can be expanded. On the other hand, the non-profit sector can increase the likelihood of alternative courses of action being explored for politicians through its promotion of science. What always remains a challenge is managing to ensure that findings actually penetrate the political process.

Robert Doubleday

“The system works too well to some extent. We have discussed the ways in which the role of the chief scientific advisor has given rise to a particular hierarchy of disciplines. There is a sense in which the physical sciences, engineering and biology sit as it were at the top table of scientific advice in the UK system while social sciences have more of a struggle to contribute to the discussion.”

Ottmar Edenhofer

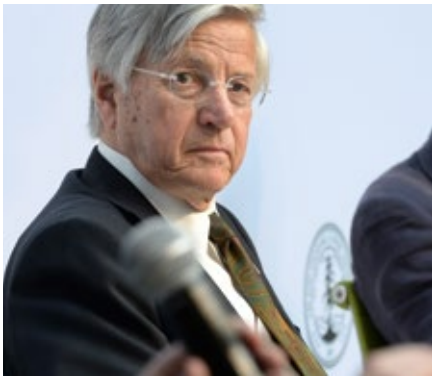
“Professors are eager to communicate to policy-makers the ideas they already had in their minds for years – this is not assessment-making. Assessment-making means exploring different pathways, yet the scientific system is not very well equipped to do this.”

Sir Peter Gluckman

“When we see science misused as a proxy for political debate and where debates are clearly value-based rather than knowledge-based, that is where things break down. Trust can also break down when scientists become extreme advocates and go well beyond the evidence.”

Kenneth Prewitt

“To function properly, public funding sources require some sort of overview of the comprehensive science we need for society. Since private funders are able to pick and choose, they are ultimately bound to leave gaps.”



GRAND CHALLENGES: A COMMON CONCEPT FOR SCIENCE AND POLICY?

Das Konzept der Grand Challenges wird seit einigen Jahren sowohl von der Wissenschaft als auch von der Politik genutzt. Bei den in Rede stehenden Herausforderungen handelt es sich um solche, die in mindestens drei Dimensionen komplex sind: fachlich, zeitlich und gesellschaftlich. Es geht um gesellschaftliche Großprobleme (Klimaschutz, Überbevölkerung, Nahrungssicherheit, Wasserversorgung, Infektionskrankheiten etc.), die auf lange Sicht bestehen, deren Kosten im Laufe der Zeit zunehmen und die dabei das Leben von Menschen auf sehr unterschiedliche Art und Weise (global) beeinflussen.

Das Konzept wird von Wissenschaft und Politik gleichermaßen genutzt: Die Politik fordert im Namen der Grand Challenges Beiträge der Wissenschaft ein, Letztere stellte und stellt diese Beiträge immer wieder in Aussicht. Weil Angebot und Nachfrage nicht immer zur Deckung kommen, sind die Grand Challenges ein kontrovers diskutiertes Thema. Dies hängt auch damit zusammen, dass sich die Wissenschaft mit ihrer tatsächlichen Verpflichtung in Bezug auf Beiträge zur Lösung der genannten Fragen durchaus schwertut. Das gegenwärtige Werte- und Belohnungssystem der Wissenschaft basiert eher auf einer Publikationspraxis und einem Forschungstyp, der nicht die Entwicklung von Ansätzen zur Lösung der Großprobleme prämiert. Es ist fraglich, ob die gegenwärtig bestehenden Forschungsstrukturen und die damit einhergehenden Pfadabhängigkeiten einen Kulturwandel in der Forschung zugunsten von Lösungsbeiträgen für die Grand Challenges unterstützen.

Bei den intermediären Organisationen erscheint hingegen der Handlungsspielraum zugunsten der Grand Challenges größer. So adressieren beispielsweise fast alle privaten Thinktanks im Grunde Grand Challenges.

The concept of Grand Challenges has been applied for some years in both science and policy, and refers to challenges that are complex in at least three dimensions: the technical, temporal and societal dimensions. These are major long-term challenges faced by society (climate change mitigation, overpopulation, food security, water supply, infectious diseases etc.) whose costs will increase over time and which (globally) influence the lives of people in very different ways.

The concept is used equally in science and policy: politicians call upon scientists to make their contributions to resolving the Grand Challenges, while scientists have promised and indeed repeatedly promise to make such contributions. Since supply does not always equal demand, the Grand Challenges are the subject of controversial discussion. This is partly to do with the fact that science by no means finds it easy actually to commit itself to contributing to the resolution of such questions. The current system of valuing and rewarding science tends to be based more on the practice of publishing and a kind of research that does not put a premium on developing possible solutions to the Grand Challenges. It is questionable whether the research structures that currently exist and the path dependencies that they entail will support a shift in research culture in favour of contributing solutions to the Grand Challenges.

Intermediary organizations, on the other hand, appear to have greater scope for taking action on the Grand Challenges. For example, nearly all private think tanks address issues which are essentially Grand Challenges.

Reinhard Hüttl

“The kind of Grand Challenges that were mentioned before – for example health, energy, IT or security as a whole – require critical mass: we need at least to some extent to pool resources, we need interdisciplinary work, and we need to focus more on trying to apply the results that we attain with these kinds of strategies.”

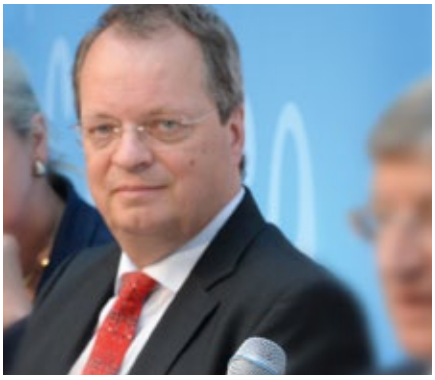
Maritta Koch-Weser

“At the nexus between science and policy, we need science to underpin what is known as sustainability. We need science-based sustainable rainforest management.”

R. Andreas Kraemer

“Some people equate governmental interest with public interest. I dispute that. A government is only a very small part of the public, and independent organizations – including universities – have a role to play in serving a wider public interest than a government can ever do.”

“We discuss with governmental clients and sponsors how results should be presented. Though the form is debatable, the result itself is not.”



Wolfgang Marquardt

“The identification of Grand Challenges always implies a deliberative process of priority-setting which is by its very nature a political process.”

MEDIA: NEW STRATEGIES FOR THE PRODUCTION AND DISSEMINATION OF KNOWLEDGE

Eine entscheidende Rolle im Verhältnis zwischen Wissenschaft und Politik spielt die Kommunikation. Für den systemübergreifenden Dialog existieren eine ganze Reihe von Instrumenten wie z. B. Gutachten, Expertisen oder Stellungnahmen. Durch die Neuen Medien wird dieses Instrumentarium erweitert. Die Teilnehmer diskutierten, welche die Konsequenzen dieser technologischen Veränderung für die Wissenschaftskommunikation sind. Als problematisch wurde gesehen, dass innerhalb der Gesellschaft eine Erwartungshaltung bezüglich der sofortigen und kostenfreien Verfügbarkeit von Wissen entstanden ist und gleichzeitig das Verständnis dafür abgenommen hat, dass Wissen Zeit braucht, um sich zu entwickeln. Auch ist es unter den veränderten Kommunikationsbedingungen noch schwieriger, die wissenschaftliche Qualität von Wissen zu beurteilen. So kann die Verfügbarkeit des Wissens zunehmen, seine Validität und Verlässlichkeit zugleich abnehmen. Die Nutzung der Neuen Medien in der Wissenschaftskommunikation bietet jedoch auch Vorteile. Eine besondere Qualität der Neuen Medien liegt beispielsweise in ihrer Fähigkeit, eine große Zahl von Adressaten zu erreichen, deren Beteiligung zu erleichtern und verschiedene Formate (Text, Bild, Filme, Diskussionsforen etc.) zu kombinieren.

In den Augen der Diskussionsteilnehmer sind Qualitätsmassenmedien für den dauerhaften Dialog und den Austausch zwischen gesellschaftlichen Eliten jedoch nach wie vor zentral. Wissenschaftsjournalisten sind dabei als Intermediäre für die Vermittlung wissenschaftlicher Erkenntnisse besonders relevant. Auch Stiftungen können unter Umständen als Intermediäre agieren, vor allem wenn die traditionellen Vermittler, wie die Printmedien, aufgrund ökonomischer Probleme geschwächt sind.

Communication plays a crucial role in the relationship between science and policy. A whole host of instruments is available for dialogue between the different systems, including expert reports and opinions – a range that is growing thanks to the new media. The panellists discussed what consequences this technological transformation has for scientific communication. One aspect that was felt to be problematic was that society has come to expect knowledge to be immediately available and free of charge, while at the same time becoming less prepared to accept that it takes time for knowledge to evolve. Furthermore, the changed communication conditions also make it even more difficult to assess the scientific quality of knowledge. As a result, the availability of knowledge may increase while its validity and reliability decrease. Nonetheless, the use of new media in scientific communication also offers advantages. One particular quality of the new media for instance is their ability to reach a large audience, to facilitate its participation and to combine different formats (texts, images, films, discussion forums etc.).

In the opinion of the discussion participants, however, quality mass media are still essential for permanent dialogue and exchange between society's elites. In this context, science journalists are particularly relevant as intermediaries who communicate scientific findings. Foundations can also serve as intermediaries in certain circumstances, above all when traditional disseminators of information such as print media are weakened as a result of economic problems.

Otfried Jarren

„Innerhalb des Wissenschaftssystems kann klar zwischen wissenschaftlichen und nichtwissenschaftlichen Beiträgen unterschieden werden, unter den veränderten medialen Bedingungen ist dies aber nur noch schwierig möglich."

Karin Knorr Cetina

„In jedem System wird das, was das andere System sagt, rekonstruiert werden müssen auf Basis der eigenen Systemsprache und -kriterien. Diese Rekonstruktion ist natürlich etwas anderes als einfache Kommunikation. Bei dieser Betrachtung wird klar, dass ohne Intermediäre überhaupt nichts funktioniert. Strukturelle Kopplung zwischen Wissenschaft und Politik braucht Intermediäre verschiedener Arten und verschiedener institutioneller Konstruktion."

Bernhard Lorentz

„Boundary organizations können Brücken schlagen zwischen Wissenschaft und Politik, weil sie Reputation und Glaubwürdigkeit in beiden Bereichen besitzen."

Ehsan Masood

"The specialized nature of jobs is changing, because larger businesses are in trouble. All the highly specialized jobs which previously existed – such as editors, commissioning editors, proof readers and copy editors – are now disappearing as the previous division of labour becomes dissolved by the new media; something that is also beginning to have quite profound changes in the mainstream media."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RUDOLF STICHWEH
ANALYSING LINKAGES BETWEEN SCIENCE AND POLITICS. TRANSFORMATIONS OF FUNCTIONAL DIFFERENTIATION IN CONTEMPORARY SOCIETY

Functional differentiation of society – five cases (1750–1850)

The following paper will examine the interface of science and politics from a broad comparative and historical perspective on the function systems of modern society. From a sociological point of view, the most important thing that can be said about modern society is that it has been a functionally differentiated system for roughly 200 or perhaps 250 years. If the social structures of Europe before the onset of functional differentiation in the early Middle Ages are studied, a stratified society based on a hierarchical order of estates can be perceived. Estates which could be identified in every corner of Europe were the nobility, the clerisy, the bourgeoisie, the peasantry and, finally, groups of paupers and strangers who did not constitute an estate of their own. An estate is a corporate social order to which an individual belongs for the whole duration of his or her life and in all dimensions of his or her way of life. For the individual, complete inclusion in one and only one estate is imperative. This old order dramatically changed between approximately 1750 and 1850, though estates did not disappear completely even after this turning point, and some remnants of this old European way of life still exist even today. This illustrates a general feature of societal evolution: old principles of social differentiation almost never disappear completely.

However, the ordering of society after this watershed was then based on specialized communication systems such as religion, law, politics, the economy, science, education, the arts and the health system, to name but a few. Every individual can contribute to these specialized communication systems by participating in some of the communicative events of the system, yet nobody belongs to one specific function system in all aspects of his or her way of life. In order to be able to understand this principle of differentiation and its rise I will broaden the perspective. This paper will not only look at science and politics, but will also add some comparative remarks about art, the economy and education. I will start by presenting an argument concerning the rise of the modern form of these function systems between 1750 and 1850.

In all five cases a clear watershed can be identified in this period. As far as art is concerned, for example, it is only around 1750 and in the decades after 1750 that something becomes visible which Paul Oskar Kristeller called 'the modern system of the arts' (Kristeller 1965). In other words, the most relevant arts of the time, namely poetry, music, painting and sculpture, were seen for the first time in history as being part of and forming one autonomous and coherent cultural domain in society. They belong to one another, and as a collectivity of forms of art they

establish one system, a system which can now be called art, or, in German, die Kunst. The first person to make use of this term was probably Johann Joachim Winckelmann in his 'Geschichte der Kunst des Altertums' from 1764, in which 'die Kunst' even functions as a kind of collective subject to which he dedicates his book (Winckelmann 1764, Vorrede, XXVI).

The constellation is similar in the case of science. What we observe around 1750 is a convergence of the many divergent traditions of early modern Europe. There were mathematical traditions which had often been related to technological and military tasks, and there were the experimental traditions which had mostly been completely separated from mathematical work (Cohen 1956). At the same time as these traditions were converging, linkages between science and theology ('physicotheology') and the arts ('schöne Wissenschaften') were being loosened or dissolved. On the basis of this separation of science from other cultural domains and the convergence of the heterogeneous traditions of science, a modern system of the sciences arose which proved its identity and unity in a paradoxical way through processes of internal differentiation. Internal differentiation means the disciplinary differentiation of science, the disciplinary differentiation of science giving rise to the orientation of science towards this internal milieu of all the other disciplines and towards a "looking away from" society. And once more, a collective singular "science" emerges instead of "the sciences" (Stichweh 1984; Stichweh 1992).

In politics the parallel breakthrough obviously consists of democracy becoming available as a political regime which no longer ties political power to status resources external to the political sphere. In the midst of the American Revolution (1776–1787), even among the founding fathers (John Adams), we still find the classical idea of 'mixed government' in which differences in rank between the strata define the political institutions characterizing the political system (the 'monarchical' governor, the 'aristocratic' senate, the 'democratic' house of representatives). In parallel to this conservative position, however, there are authors who argue in favour of the conflicting idea that each single political institution finds its justification only in the sovereignty of the people as a multitude of individuals all endowed with exactly the same rights and who must therefore be characterized by their equality (Wood 1998; Ghosh 2013). These individuals who constitute the institutions of the political system have to be thought of without embedding them into other domains of society (estates).

In the economy it is between 1750 and 1850 that we observe the separation of family households from the workplaces of industrial labourers (Smelser 1959) – and in parallel, but at least a hundred years later, a separation of ownership and management on the side of the owners of industry (Chandler 1977). This invention gave rise to the corporate enterprise which is mainly governed by managers who are not born into it and who therefore have individual careers within which they change from one enterprise to other business organizations. These two inventions of management and of industrial work are two functions wholly internalized to a disembedded economy which is then completely monetized and achieves its unity on the basis of money as a mechanism.

The final example we will mention here is higher education as a subsystem of the system of education. Higher education in early modern Europe was characterized by the heterogeneity of its populations: extremely divergent qualifications with which students entered higher education, a significant spread of ages in one and the same class, the emergence of higher educational institutions specializing in specific strata (e.g. colleges for the nobility) (Stichweh 1991). Around 1800, this heterogeneous system gave rise to the modern university which was built on the basis of secondary schools which homogenize and standardize the preparation of students via examinations (Matura, Abitur). A second relevant development is the disappearance of higher educational institutions specializing in specific strata. The modern university is much more clearly an educational institution taking its place in an age-related succession of schools. It caters much less to the needs of specific (privileged) strata in society. Instead it is a general educational institution which thereby lays the foundations for its late 20th century career of becoming an institution which accommodates ever-growing shares of the relevant age groups in ever more countries in the world.

Semantics of autonomy and purity

The first part of this paper described five functional domains in society, all of which became visible in their newly established unity in the years between 1750 and 1850, and all of them are prototypes of the new principle of functional differentiation of society. What can be documented in all of these cases is something that could be called a regression to autonomy and purity – i.e. a

"THIS STRUCTURAL COUPLING OF SCIENCE AND HIGHER EDUCATION WAS FACILITATED BY 'SELF-CULTIVATION' AS THE CONTEMPORANEOUS PURITY IDEA OF EDUCATION."

Rudolf Stichweh

prevalence of a semantics of autonomy and purity used to establish a strong case for the existence of the new functional spheres.

In the system of art we have the idea of "l'art pour l'art", a formula probably coined in 1804 by Benjamin Constant (Egan 1921) and used to reject all ideas about the educational, devotional, decorative and other external functions of art, insisting on the 'Eigenvalue' of the sphere of art which is not derived from the usages of artefacts of art by their owners and observers. Some decades later (after 1860) the idea of modern art was added, discarding historical differences between artefacts by attributing them to one collective movement called modern art which operates with a projective horizon by including many artefacts from many regions in the world and reinterpreting them as "modern" in a formalistic understanding of this concept of modernity. Finally, the tendency towards abstraction in the 20th century is the culmination of this self-limitation of the system of art.

In the case of science we can observe the idea of 'purity' (cf. Abbott 1981), for example in 'pure mathematics'. Parallel concepts are those of 'basic science' and 'fundamental science' – and in an interesting formula the idea of an 'ivory tower' in which science searches for and finds its (non-)place in society.

There are many educational ideals in higher education, some of them expressing the self-sufficiency of education. One especially interesting example is the semantics of 'self-cultivation' ('Bildung') which became prominent once more around 1800. Self-cultivation postulates a coupling of individuality and education that does not accept goals external to the process of education (cf. Bruford 1975). It is a sphere of pure individuality in which each individual becomes a world in his or her own right, needing no external legitimation. The same coupling of a radical individualization of inclusion and the autonomy of a functional sphere can finally be found in the idea of democracy being the foundation of a political system which generates all its values and goals in its own internal system processes and therefore only includes 'pure' individuals devoid of all external conditions and determinants. In the economic sphere, the concept of purity finds its counterpart in the belief that financial markets constitute the core of the economic system, the innermost reality of hat the economy is all about.

The age of linkages (1850–2015)

After this period around 1800, which was very much characterized by the semantical formulation of autonomy and purity, a completely different developmental trend can be observed in many of the function systems of society from the beginning of the 20th century to the present day. I propose that this later period be named 'the age of linkages'. This paper will study this only with respect to the system of science (for a more general hypothesis regarding evolutionary trends in functional differentiation, see Stichweh 2014a; Stichweh 2014b).

The most important linkage of the system of science, the linkage to higher education, arises simultaneously with the purity ideals for this system, namely in the transformation of the European university as a result of the institutionalization of the research imperative – i.e. the normative expectation that every university professor should pursue research – and at the same time the

formulation of the unity of teaching and research. This structural coupling of science and higher education was facilitated by 'self-cultivation' as the contemporaneous purity idea of education. These ideas could be observed as dominating ideas for somewhat more than a hundred years; after which they were replaced in Max Weber's 'Wissenschaft als Beruf' (Weber 1917) by a completely disenchanted new vision of pure science as something devoid of any (self-) cultivating effects.

The linkage between science and politics is given a new twist around 1900. This can be perceived in the concept of 'science policy' (Wissenschaftspolitik), which appears to have emerged in the first decade of the 20th century. Previously, only higher educational institutions were planned and steered politically, yet politics did not know or think about science as the object of a policy domain in its own right. Today, a significant policy domain known as 'science policy' can be observed in virtually every country in the world, producing plans and documents and strategies of its own.

At the same time as science policy emerged, science began to be dependent on instruments and support personnel. Scientific research that depends on instruments and personnel needs ever more financial support. This intensifies the linkage to politics as well as to business organizations that pursue applied science or technology development. Around 60 to 70% of research in many OECD countries today is financed by business organizations which conduct research in their own laboratories. These laboratories, being physical and organizational infrastructures, constitute a further linkage between science and a business world based on completely different cultural premises.

The patent system emerged as a linkage between science and law that is closely related to the technological and economic relevance of science (Mersch 2014). Patents give legal protection to inventions that combine technological novelty with potential usefulness. The owner of the patent acquires an exclusive right of usage for a specified period, and in return has to agree to the publication of the new knowledge as part of the patent application. Another linkage of science which is both old and a very recent phenomenon in its present form is the linkage to ethics. Whereas this linkage existed as the perceived incompatibility of certain scientific practices with societal norms in the 18th and 19th centuries, today it is institutionalized in the form of explicit procedures and commissions designed to examine the ethical admissibility of planned projects, a formal decision being taken at the end of these procedures to allow or forbid the envisaged research.

Furthermore, there is the public sphere to which a linkage is established via public processes of communication about science. Nowadays, one institutional term for this is the 'public understanding of science', which is often described as an institution to which every practising scientist is expected to contribute to some extent.
The final linkage I want to discuss is not to one of the other function systems in society but to society itself. It has long been the case that this has not been a visible dimension in discussions about the social relevance of science. When we speak about 'Grand Challenges' or about the 'responsiveness of science' in present-day society, however, it is clearly society itself which functions as the system of reference. This has the interesting implication that science perceives itself as being a societal institution which in certain respects addresses society directly rather than channelling its information and advice via politics as it previously did. In this respect science is no longer something which communicates information to participants in the public sphere who then make use of it. Instead, the system of science itself becomes one of the core actors of the system of observers of politics and society which we call the public sphere.

Why do linkages arise?
Why do such linkages come about? I will not attempt to answer this question exhaustively at this point. However, there are some obvious conditions which can be denoted by terms such as inclusion and globalization, growth and expansion. At first, around 1800, the function systems were small systems prominent only in some regions of the emerging world society. For such small institutional complexes relevant only to few people, a semantics of purity may have been wholly adequate. At the time this highlighted the relative marginality of these highly innovative, unusually specialized functional communication complexes.

The two most important societal trends then are globalization and inclusion (for the interrelation of globalization and inclusion, see Stichweh 2003). 'Globalization' means

the geographical ubiquity of institutional complexes which initially were present only in a small number of regions. 'Inclusion' then means the growth of these institutional complexes in the respective regions which occurs when individuals are increasingly addressed as participants of the institutional complexes. This can be illustrated by looking at higher education. Higher education had been a well-established institution in European society which for seven centuries (1200–1900) never included more than 1–2% of the male population of some European regions in its educational and scientific processes. In the few decades between 1950 and 2014 this percentage of the population included in higher education grew in most OECD countries to 30–90% of the relevant age group (now male and female). Over the same period, the university became a universal institution which is to be found in every country of the world, and in this sense one can speak of a process of globalization closely related to the simultaneous process of inclusion. It can easily be seen that these two processes of globalization and inclusion ultimately result in the enormous growth and expansion of the function systems. It is reasonable to assume that the combination of these processes will result in function systems of an enormous institutional complexity for which the emergence of numerous linkages to other functional systems is a plausible consequence. To this extent the rise of linkages is first and foremost an effect of the growth of function systems.

The internal representation of external points of view

There are three more specific characteristics of function systems that create ever more linkages to the other function systems. The first and perhaps most important of these characteristics is that institutions can be observed to emerge in all function systems in society which are internal to the respective function system but which somehow represent the points of view and the competences of other function systems and do so within the communicative domain of the first mentioned function system.

I will illustrate this argument by referring to the example of the political system. First of all – at least in OECD countries – politics today tends to be democratic politics and as such is to some extent a self-sufficient domain of society in which many actors are mainly concerned with obtaining votes and winning elections. In democratic

"TO UNDERSTAND THE SITUATION OF SCIENCE IN CONTEMPORARY SOCIETY, IT IS VERY IMPORTANT TO REALIZE THAT SCIENCE IS STRONGLY LINKED TO SOCIETY, PERHAPS EVEN MORE STRONGLY THAN IT IS LINKED TO POLITICS."

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systems, aspects such as the quality of politics, the quality of government (Rothstein 2011), the effectiveness of what one is doing and the ability to genuinely shape and change society are often secondary to winning elections. This can be seen as a problem and a weakness of democratic political systems. It is important to analyse these limitations of democratic politics. It is interesting to note how institutions emerging in the system of politics today are related to this problem. There are first of all central banks. The existence and prominence of central banks means that it is accepted in politics – and especially in democratic politics – that some very important, indeed perhaps the most important, economic policy decisions are not taken or are no longer taken by democratic institutions but rather by wholly autonomous agencies which take decisions on the basis of the competencies that have been transferred to them (Crowe and Meade 2007; for economic experts in politics, see Hallerberg and Wehner 2014). These are expert organizations which recruit staff not on the basis of political elections but look for monetary experts whose reputations are more scientific than political.

A second example are constitutional courts, which operate according to the same principle (Stone Sweet 2002). Basic decisions about the constitutionality of acts of legislation are taken by an expert organization whose members (who have to be judges) are chosen by committees in the political system but, once elected, can be sure of their independence thanks to their long – and in some cases life-long – terms of office. A third case in point is the licensing of pharmaceuticals. Once again this is done by an organization which may have to base its decision practice on politically set premises (e.g. regarding the licensing of natural remedies which often are privileged by politicians), but in all other respects is much more of a scientific than a political institution.

A last and very pertinent case in terms of studying linkages between science and politics is scientific advice to politics. Advising the ruler or monarch was close to the core of early modern politics in Europe. Advisors were learned people, mostly jurists, though also representatives of the interests of the other estates of the realm (Stichweh 2006). The situation today is much the same, yet different in other respects since political advice no longer has to do with the representation of interests of estates or strata. If any interests are represented then they are the interests of science as a knowledge system and of its protagonists. Providing scientific advice can politicize science (see as an example the IPCC). At the same time, and these are perhaps the most interesting cases in terms of political sociology, scientific advice may imply a depoliticization of domains of political decision-making, and perhaps some depoliticization is necessary for scientific advice to be effective. Otherwise it could fall prey to the adversarial nature of politics, each political vision or option supporting itself with some scientific advice of its own. However, if politics in a specific policy domain were to lay its adversarial nature to rest for a limited period and were to listen to scientific advice, we might find ourselves witnessing the birth of a new institution of depoliticized, domain-specific, expert-generated decision-making.

The linkage between science and society

To understand the situation of science in contemporary society, it is very important to realize that science is strongly linked to society, perhaps even more strongly than it is linked to politics. This argument interprets society as the social domain which encompasses all the function systems. The intensification of linkages to society in a comprehensive understanding of this term can be observed with respect to several of the function systems which have been discussed in this paper. Furthermore, this will probably imply in all cases a loosening of the linkages to politics. A good example is the university, especially universities in the United States. Universities in the US are no longer – and probably never were – bureaucratic institutions and as such part of the institutional apparatus of government. They are autonomous organizations, and as such much more institutions of society than executive organs of government. The board of governors, being the central steering organ of the American university, is designed to represent as many perspectives from society (and its functional subsystems) as possible. European universities have been moving in the same direction in recent decades (Stichweh 2009; Stichweh 2014b).

The situation is similar as regards the system of science. As soon as science turns its attention to what we call 'Grand Challenges' and attempts to become responsive to society, finally discovering climate change as perhaps the most dramatic problem facing the future of contemporary society, an interesting shift occurs in the interrelation of science

and politics. Science can no longer say: "We discovered this societal core problem of 'climate change'. And now, having done this and having diagnosed its extent, having prognosticated possible future developments and risks, we hand this knowledge over to political decision-makers and place our trust in politics, providing merely information and further advice about this problem".

A more adequate description seems to be that a kind of responsibility rests and remains with the system that discovered and diagnosed the problem in the first place and which understands the problem best of all the systems in society. Observers within the system of science may perceive this as a kind of obligation to take care of a problem one knows best and which one cannot leave to politics, i.e. to a system which very often and in many countries in the world happens to be a dysfunctional system, a system based on the primacy of an electoral process, a primacy of turning out votes and getting votes and winning elections. Of course, electoral competition is a very fascinating thing in itself, but it does not at all guarantee the quality of government – and therefore interested observers having their platform in science can live under the impression that they have to compensate for what politics is not able to do by itself.

The pluralization of politics

The relativization of politics by the internal representation of external concerns (representation of the perspectives of other function systems in a given function system) and the increasing relevance of other societal systems (i.e. the pluralization of functional perspectives inside society) is in a third respect furthered by an internal pluralization of politics. A political system today no longer only means a national state and its governmental apparatus. There clearly exists today a multi-level structure of government internal to a given national state – and furthermore a system of global governance which is a second big system of politics besides and parallel to the system of national states.

This system of global governance consists of many thousands of organizations, only some of them governmental, which have an autonomous way of looking at different domains of society and of doing political work and participating in political decision-making regarding these domains of society. Among these organizations there are foundations and charities and many other types of political organizations. Again we have to do with expert organizations which combine a substantial political engagement they want to work for and a kind of expertise they acquire.

All of them are part of the pluralization of politics. And what is interesting in all of these organizations is that in their internal processes they are able to do something which is more difficult for function systems than for organizations: organizations are able to combine problem perspectives from several of the function systems of society. A foundation, for example, can

look at science and learn about science and internalize science and even do scientific research – and on this basis it can try to change society. Of course, it will never change the whole of society, which is something which nobody will ever be able to do. But it can participate in solving very concrete problems internal to society. For it and for the other organizations there is no need to wait for political actors. Being an activist organization it will not wait until classical political actors come and solve societal problems. The organization will try to do it itself – and this is a classical example of the ongoing pluralization of relevant political actors in the political systems of our days.

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DANIEL SAREWITZ
ANALYSING THE LINKAGES BETWEEN SCIENCE AND POLITICS: CAN THIS MARRIAGE BE SAVED?

Several months ago I was asked to provide some guidance for an American philanthropic foundation that had invested a truly enormous amount of money – hundreds of millions of dollars – in trying to stimulate effective action on climate change in the United States, and whose staff seemed frustrated and somewhat uncomprehending about why they had failed to make a significant difference in the policy landscape. According to one senior staff member, the foundation had invested in "an engineering approach" designed to provide "the right technical advice to implement and carry out" policies. They wanted to support "really smart decision-making about the best options" to reduce the "greatest number of tons" of carbon emissions. For this foundation, the relationship between science and politics was simply for science to provide "the right technical advice." But, in the words of this staffer, it turned out that the world was "messier" than they had thought. They had not, the staffer reported, anticipated the central role that politics would continue to play in the climate change arena.

I take it that the experience of that foundation is an example of why Stiftung Mercatur is concerned about "the relationship between science and politics", and why we are talking about it here today. I've been asked this morning to consider and address a number of questions about "the relationship between science and politics." Has it changed in recent years? Are tensions in this relationship increasing, and if so, can that be reversed? Can civil society actors do anything to improve the relationship? Has the significance of science for politics increased or decreased?

These are good, hard questions, presumably meant to stimulate careful reflection on the lessons of several decades of fairly gruelling debates that seem to have brought science and politics together in ways that no one is very satisfied about. The list is familiar: climate change of course, but also nuclear waste disposal and GMOs, embryonic stem cell research, toxic chemical regulation, ecosystem protection, autism-and-vaccines, BSE and foot-and-mouth disease, and so on.

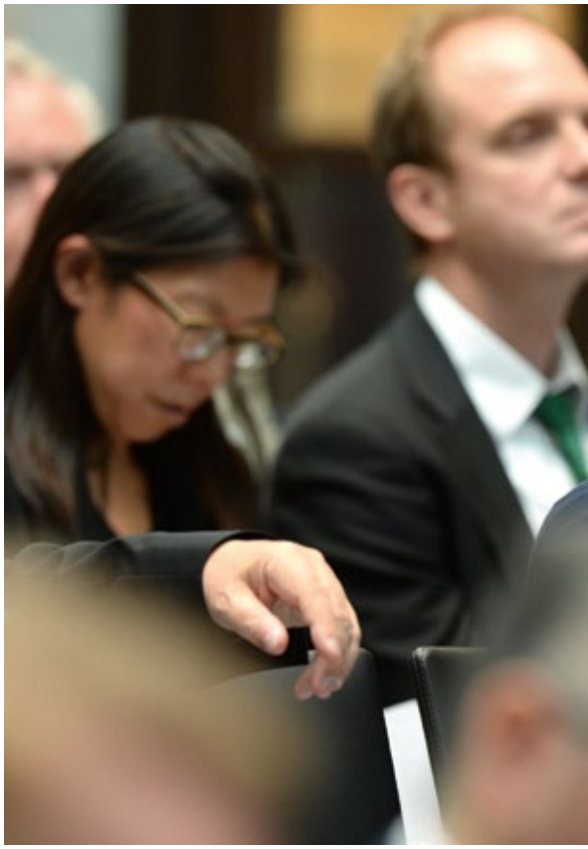
In reflecting on such questions over many years, I find myself increasingly thinking that much of the difficulty lies in the very idea of a "relationship between science and politics," and our almost instinctual expectations of how that relationship ought to work. And I take it we are expected to be troubled because it seems like the relationship, as we say when we talk about relationships between people, actually "isn't going all that well." Science and politics – yes, they come from two quite different families

and cultures, but they seem to be deeply attracted to one another, with strengths and weakness that ought to be beautifully complementary. So why, instead, do we often see mutual disappointment and misunderstanding, conflict, mistrust, and a simple inability to communicate with each other? We who care about the relationship want science and politics to find a way to get along more nicely.

I think this hope for a relationship at once amicable and intimate is probably a vain one. When science and politics marry, they are marrying into discord.

Back in 1958 the great chemist and nuclear disarmament activist Linus Pauling, and the physicist and hydrogen bomb designer Edward Teller, debated on television whether or not there should be a nuclear test ban treaty[1]. Pauling's opening argument starts with a statement about the danger of nuclear war and then quickly gets into questions about factual accuracy of media reports on the danger of fallout. He explains how he got more than 9000 scientists from around the world to sign onto a letter he wrote that called for an end to bomb tests. He then supports the need to end the tests almost entirely on the scientific claim that radioactive fallout from atmospheric nuclear tests would cause genetic defects in humans. "I have estimated that the amount of increase in the mutation rate as the result of radioactive fallout carried on at the present rate is one percent – a one percent increase in the number of defective children who will be born in the future ... 15,000 seriously defective children a year."

Teller countered in an interesting way. First, he insisted that both he and Pauling had the same overriding concern – the preservation of peace in the world – but he then explained that he had a different view about the best pathway to peace, arguing that a cessation of bomb tests was the equivalent to disarmament, and that disarmament could embolden the Soviet Union to be more aggressive, thus endangering freedom. Peace must be preserved at all costs, he said, except "when the freedom of human beings is at stake." Only after making these points did Teller try to cast doubt on Pauling's scientific claims, saying that the danger from fallout caused by atmospheric tests "has not been proved, to the best of my knowledge, by any kind of decent and clear statistics. It is possible that there is damage. It's even possible that there is no damage; and there is the possibility, furthermore, that very small amounts of radioactivity are helpful. Some people believe in the healing powers of radioactive waters. I do not. It is an unscientific belief. The conviction that small amounts of radioactivity are necessarily damaging is, I think, not proved either."



"ONE OF THE PERSISTENT ELEMENTS OF THE 'RELATIONSHIP BETWEEN SCIENCE AND POLITICS' IN DEMOCRACIES IS THE SPECTACLE OF DUELLING EXPERTS."

Daniel Sarewitz

Perhaps the most obvious point here is that this debate illustrates one of the persistent elements of the "relationship between science and politics" in democracies – the spectacle of duelling experts. And if I manage to put aside my own very negative views about Teller's role in history, I have to say that I admire his approach in this debate, indeed much more than that taken by Pauling. Teller starts by making clear both his values and his theory of the world, and only then does he get into the science. Indeed, by the time he gets to the science, it is almost irrelevant, because if you happen to accept his view of the Soviet Union, then, as Teller actually says, the rather small possible dangers from bomb-test radiation are far outweighed by the need to remain competitive with the USSR in nuclear weaponry in order to protect freedom. Pauling, on the other hand, seems most interested in settling matters of factual disagreement, which weakens his ability to communicate moral conviction.

Some 14 years later, which is still a long time ago, another Cold War physicist, Alvin Weinberg, noted[2] that "[m]any

of the issues which arise in the course of the interaction between science and society … hang on the answers to questions which can be asked of science and yet which cannot be answered by science." The first example he used to illustrate this general point was, coincidentally, the biological effects of radiation. Weinberg does some simple arithmetic to show that you'd need eight billion mice to see if a 150 millirem annual dose of radiation led to a half-percent increase in mutation rate at 95 percent confidence level. "The number is so staggeringly large that, as a practical matter, the question is unanswerable by direct scientific investigation. Moreover, no matter how large the experiment, even if no effect is observed, one can still only say there is a certain probability that there is an effect."

And so, Weinberg reminds us, such questions would have to be addressed politically, not scientifically. A relationship between science and politics was required. Not only that: it would have to be an adversarial relationship, because in the end the decision would be based on values. Here Weinberg was prescient: "The adversary procedure is likely to be used increasingly in modern, liberal societies in their attempts to weigh the benefits and risks of modern technology." Therefore: "Confrontation between scientists of opposing ethical or political positions is desirable." Weinberg goes on to make two other crucial observations. First, "to the scientist, adversary procedures seem inappropriate and alien." Second, "[o]ne must establish what the limits of scientific fact really are … This often requires the kind of selfless honestly which a scientist or engineer with a position or status to maintain finds hard to exercise."

Teller and Weinberg occupied politically opposing poles, with Teller a conservative stalwart beloved by Republican leaders, and Weinberg having the honour in 1973 of being fired as director of Oak Ridge National Laboratory by President Nixon for insisting that nuclear reactors be made safer. But many decades ago they were offering us the same crucial lessons about the relationship between science and politics, lessons that we still seem to resist and that, today, we seem unable to face up to, to the detriment of both politics and science.

The Pauling-Teller debate illustrates beautifully what Weinberg was describing. The event was adversarial in the public and productive way that Weinberg had in mind. In Teller's case at least, there was really no pretence that the debate was essentially about science. The disagreement was a political one, bringing into sharp contrast the beliefs, assumptions and value preferences of the adversaries. Pauling's effort to focus the exchange on the science did not serve his position well; reading the debate transcript, one feels that Pauling's debate tactics were confused and somehow missing the bigger point; he seems outmatched precisely because his passion seems to be about what the facts say about mutation rates, rather than about the much larger moral and political questions raised by the nuclear arms race.

Here I want to point something out about the state of the science at the time that bears on the overall problem. Pauling asserts complete certainty in science that today sounds, even with my modest level of understanding of such things, like a rudimentary back-of-the-envelope calculation at best. Teller's scepticism of Pauling's confidence seems well founded. Weinberg's subsequent

assessment of the same scientific problem seems a bit more sophisticated and complex, but is still necessarily oblivious to the complex relations between single mutations and pathogenesis, or the difficulties of extrapolating much of anything from mouse models to human beings, issues that would be brought to light from continued research, thus adding to complexity and uncertainty, rather than reducing it.

The moderator ends the Pauling-Teller debate by saying "It is apparent that the issue has not been resolved. I'm sure that our guests would agree that its ultimate solution rests in our hands, that each of us bears the moral obligation to examine the evidence, draw conclusions from this evidence and act upon our convictions." He seemed comfortable with the combination of inconclusive evidence, moral obligation and the role of the citizen in coming to public judgement, more comfortable than one might observe in similar debates going on today.

In 1972, Weinberg had it about right. He understood that most problems at the intersection of science and politics had to be recognized as essentially political. He realized that what might seem like the key scientific questions associated with such problems were very often unanswerable by science. He did not expect scientists to acknowledge these limits, however, and so he anticipated that science and politics would become increasingly difficult to separate. He looked towards adversarial processes as centrally important in addressing such problems, at least in democratic countries. And he expected such problems to become more pervasive over time. He did not anticipate a smooth, amicable, mutually respectful, conflict-free relationship between science and politics. Yet I suspect he did anticipate that these problems would sort themselves out politically precisely because clashes among experts, as exemplified by the Pauling-Teller debate, would make clear the nature of the differences in values and worldviews lying beneath the technical disagreements, differences that all could agree had to be adjudicated through politics, and through the judgement of citizens.

This kind of clear division of labour clearly has not strongly emerged in issues such as climate change, GMOs, environmental restoration, chemical regulation or nuclear power. Such problems each have their own distinctive complexities and difficulties, but their essentially political nature has not been acknowledged in the rhetoric of political debate. Not only do the science and the politics remain deeply intertwined, the combatants continue to insist that their positions are based on scientific facts, and they continue to provide technical arguments, and mobilize technical experts, to advance these positions. To escape from this condition, at the very least the experts, as Weinberg encouraged them to do, would have to acknowledge the limits of their own relevant knowledge, and everyone else would have to acknowledge that the essence of the controversies can only be settled politically. It's obvious why experts wouldn't want to make themselves irrelevant in these debates; but why is everyone else committed to fighting out politics in the language of science? We all want to be rational, of course, and perhaps the idea that one's political views are fact-derived provides, somewhat ironically I suppose, a psychologically convenient way to dismiss one's opponents as simply irrational. This absolves one of any need to try to understand or empathize with them, which in turn makes the quest for political solutions, which so often are about achieving compromise, even more difficult. There is certainly some indirect evidence of this hypothesis in the U.S., where survey data show that there is no meaningful difference in the levels of science literacy between those who favour strong action on climate change and those who do not, even though a standard accusation of climate change activists is that the opponents of action are anti-science.

Can this marriage be saved? Should it be saved? Let me offer four general suggestions.

The first is marital counselling. When science and politics are forced into what we in the U.S. might call a shotgun marriage[3], so that a particular political pathway becomes associated with a set of scientific assertions, the tensions cannot easily be overcome. The best we can do, I think, is to try to understand and empathize with the reasons for disagreement as a first step towards seeking pathways forward. One of the things I've done recently in this regard, in my role as editor of the science policy magazine Issues in Science and Technology, is to publish two articles, authored by experts with genuine conservative credentials, that present a conservative perspective on the climate change problem and the sorts of political options they would favour for addressing it.[4] My goal here is to begin to make it possible to realize that disagreements

“UNTIL THE COMPETING SIDES IN THE DEBATE HAVE ACQUIRED SUFFICIENT IMAGINATION TO AT LEAST UNDERSTAND THE UNDERLYING REASONS FOR DISAGREEMENT, POLITICAL PROGRESS WILL REMAIN IMPOSSIBLE.”

Daniel Sarewitz

about what to do about climate are not results of one side being rational and the other irrational, but of different rationalities that haven’t learned to speak to each other, in no small part because the only language they’ve been offered is science. It’s a quixotic ambition, I know, but, at least in the U.S., until the competing sides in the debate have acquired sufficient imagination to at least understand the underlying reasons for disagreement, political progress will remain impossible.

If counselling fails, a second option is divorce and remarriage: find a different pathway to political resolution, one that isn’t linked to resolving scientific disagreement. Here, a valuable but often unappreciated example is the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. Often cited as a paragon of a successful relationship between science and politics, I regret to say that the agreement to phase out production of ozone-depleting chlorofluorocarbons became practically and politically

possible only when an alternative to science became available – in this case, a technological option provided by chemicals serving the same essential chemical functions as CFCs. Once the key political players, including the chemical industry and environmentalists, recognized that the technological option could satisfy their needs, the science – which was still unsettled while the treaty was being negotiated – became of secondary importance to achieving a resolution. While there are some who may find the idea of abandoning science for a technological fix ethically distasteful, this pathway can actually end up being good for the relationship between politics and science, by reducing the expectations for scientific certainty.

Third, we can strive to be more clear about who's boss – not science, but politics – by finding ways to let democratic politics resolve the scientific uncertainties. A valuable example here comes from the annals of high-level nuclear waste disposal. In the U.S., scientific assessment of a proposed waste site in the state of Nevada was supposed to determine whether the site was safe. But two decades and more than $10 billion in research failed to quell political opposition to the site; in fact, the science – which had to answer unanswerable questions such as: will the site be safe for 10,000 years – was mobilized by supporters and opponents alike to further the political battle, as we would expect.

Sweden has pursued a different and smarter pathway. Rather than selecting a single site and expecting the science to tamp down any opposition, the Swedish process kept candidate municipalities closely involved in the selection process – and even gave them veto power. Three towns were chosen as finalists for a waste site in 2000; one exercised its veto, and a final decision was announced in 2009, with the two finalists splitting a substantial cash reward. The primacy of democracy was never threatened. The process was iterative and incremental, searching for and finding public support along the way through inclusive politics rather than by trying to overcome opposition through a mounting body of science. Science became good enough to support action when its job was to provide options, rather than dictate a political solution.

And finally, there is the polygamy option – looking towards multiple relationships for satisfaction of different needs. Here my example comes from chemical regulation. In the U.S., the Toxic Substances Control Act prescribes the for-

mal structure for regulating toxics based on scientific risk assessments. After 40 years, it can be labelled an abject failure, having succeeded in stimulating much scientific research, enriching many lawyers in a process of endless litigation, and regulating fewer than ten chemicals out of the many tens of thousands that have been inventoried by the U.S. Environmental Protection Agency.

Recently, and in contrast to this failure of the relationship between science and politics, strange things are going on outside the U.S. national political process. The main players are public and occupational health groups – and large corporations. Several chemicals that have been at the centre of protracted scientific and regulatory battles, including formaldehyde, bisphenol A, phthalates, and 1,4 dioxane, are now being removed from supply chains by major corporations even as the risks of the chemicals are still being researched and litigated. A range of motivations are driving this trend, including the desire of companies to avoid bad publicity, or garner good publicity, and also the recognition by some, such as Walmart, that there is little economic downside and lots of potential upside to pressuring their suppliers to change the chemicals used in products.

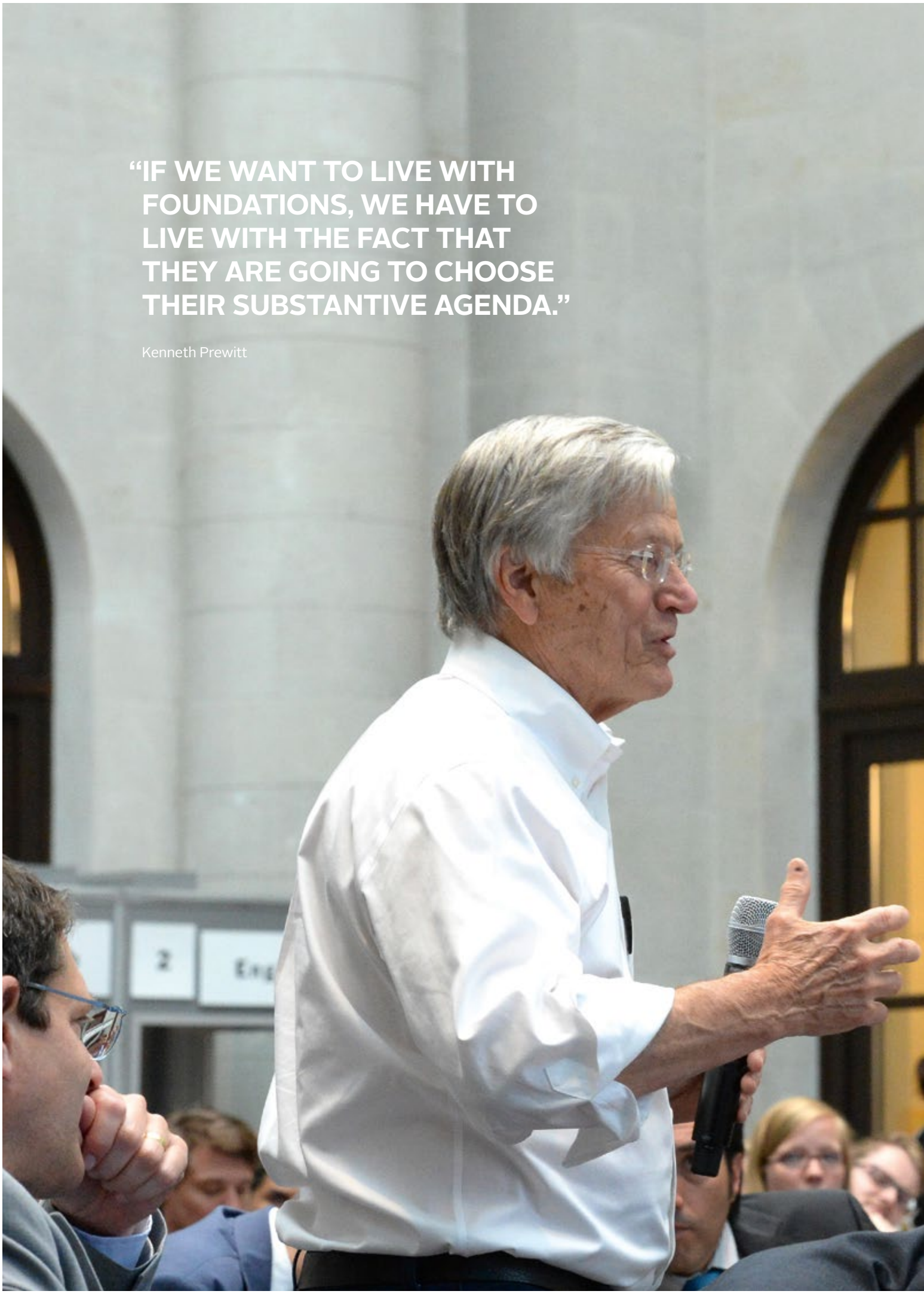
Meanwhile, recognizing the opportunity presented by corporate willingness to remove toxics from their products, corporations and environmental advocacy groups, sometimes working together, have constructed on-line databases and assessment tools containing a wide range of toxicity data on chemicals. Databases with names like Greenscreen, Pharos and ChemHAT are providing information that users of chemicals, whether enormous corporations like Walmart, smaller enterprises such as construction companies, or factory floor health and safety managers, can use to make choices about chemicals that take into account the existing state of knowledge about potential hazard. The science is no more or less settled than for the regulatory regime, but in these new relationships, the partners expect less of the science as they discover unexpected ways to satisfy one another politically.The idea that in a well-functioning society politics and science will live together intimately, amicably and productively is a seductive one, an appeal to our self-image as rational modern people, but this is a seduction we need to learn to resist. Obviously we want to understand the world we live in as well as we can as a part of making wise decisions, but when we disagree about appropriate ends, means or both, the types of questions that such disagreements pose for decision-makers cannot be cleared up by science. The thumbnail examples I've presented here are meant to show that smart approaches to politics can reduce the expectation that science can or should settle arguments that are irreducibly political. We don't need to give up on the relationship, but we ought to be open to the idea that breaking an unhealthy co-dependency in a way that forces both politics and science to act a bit more like independent and mature adults is an important step towards a more rewarding relationship.

[1] "Fallout and disarmament: A debate between Linus Pauling and Edward Teller," 1958. *Daedalus* 87(2): 147–163.

[2] Alvin Weinberg, 1972. "Science and Trans-Science." *Minerva* 10: 209–222.

[3] For those unfamiliar with this expression, simply imagine a father, shotgun in hand, accompanying his pregnant daughter and the boyfriend who helped put her in that condition as they walk down the road from the farmhouse to the chapel.

[4] D. Garman, K. Emanuel and B. Phillips, 2014. Breaking the Climate Deadlock. *Issues in Science and Technology* (summer): 75–82.
S. Haywood, 2014. Conservatism and Climate Science. *Issues in Science and Technology* (spring): 52–57.



“IF WE WANT TO LIVE WITH FOUNDATIONS, WE HAVE TO LIVE WITH THE FACT THAT THEY ARE GOING TO CHOOSE THEIR SUBSTANTIVE AGENDA.”

Kenneth Prewitt

SCIENCE FUNDING: DEALING WITH POLITICAL EXPECTATIONS

Das Panel diskutierte die mit öffentlicher Förderung einhergehenden politischen und gesellschaftlichen Erwartungen an die Wissenschaft. Sollte nur diejenige Forschung staatlich gefördert werden, die der Gesellschaft einen Nutzen bringt, oder sollte es der Wissenschaft überlassen bleiben, zu entscheiden, welche Forschungsfragen relevant sind? Wie sieht ein Wissenschaftssystem aus, das beide Ansprüche vereint? Und wer steuert bzw. verändert es? Wissenschaftsförderung braucht eine Reihe von Zielen und Kriterien, damit entschieden werden kann, welche Projekte zu fördern sind und welche nicht. Diese Ziele können der Wissenschaft selbst entstammen und sich somit primär auf die wissenschaftliche Qualität der Forschung beziehen oder sich aus der zu erwartenden gesellschaftlichen Relevanz der Forschungsergebnisse ableiten. Die Nützlichkeit von Forschungsergebnissen für die Gesellschaft ist jedoch nicht leicht zu bemessen, sind die gesellschaftlichen Erwartungen an die Wissenschaft doch heterogen und oft widersprüchlich. Hinzu kommt, dass innovatives Wissen oft unerwartetes Wissen ist. Somit ist Forschungsförderung paradoxerweise genau dann besonders erfolgreich, wenn sich ihre Prognosen in Bezug auf das Ergebnis als falsch erweisen. Der Blick auf die unmittelbaren gesellschaftlichen Wirkungen von Forschung kann daher kurzsichtig sein.

Einig waren sich die Diskussionsteilnehmer darüber, dass die Forderung nach wissenschaftlicher wie auch nach gesellschaftlicher Relevanz gleichermaßen legitim ist. Für beide Bereiche wird eine Finanzierung als notwendig angesehen. Komplexe Finanzierungssysteme, in denen verschiedene Wissenschaftsförderer agieren, die jeweils unterschiedliche Ziele verfolgen und Methoden anwenden, können dazu beitragen, dass eine vielseitige Forschungslandschaft entsteht bzw. erhalten bleibt.

The panel discussed the political and social expectations that arise when science is publicly funded. Should funding be made available only to research that will entail benefits for society, or should it be left to scientists to decide which research questions are relevant? What form might a system of science take that combines both? And who would control or change it? Science funding requires a series of goals and criteria to allow decisions to be taken about which projects should be funded and which should not. Such goals may come from science itself and thus relate primarily to the scientific quality of research, or may be derived from the envisaged relevance to society of the results of the research. It is not easy to measure the usefulness of research findings for society, however, given that society's expectations of science are heterogeneous and frequently contradictory. What is more, innovative knowledge is often unexpected knowledge. Paradoxically, research funding is thus particularly successful when its predictions of the results turn out to be incorrect. It can therefore be short-sighted to look solely at the immediate social impact of research.

The discussion participants agreed that it is equally legitimate to demand scientific and societal relevance. Funding is regarded as necessary in both areas. Complex funding systems involving different donors, each pursuing different objectives and applying different methods, can help create or preserve a diverse research landscape.

Gordon Marshall

“I see the responsibility of scientists as being to make available the best evidence possible to those in power, if asked to do so – or even if not asked to do so.”

“If the question to be confronted is 'How ought we to order societies, how should we live our lives?', then we need to consult a prophet – not a scientist.”

Joshua Rosenbloom

“Past experience suggests that decisions that are based solely on the apparent immediate applications of particular investigations would preclude many potentially beneficial scientific discoveries.”

“There is no single homogeneous scientific community. [...] There needs to be another set of values to guide the selection of projects for funding.”

Peter Strohschneider

„Relevant ist etwas stets nur für bestimmte Personen in bestimmten Hinsichten. Relevanzannahmen werden daher immer umstritten sein und sich ändern. Wer von Forschung Relevanz fordert, muss dies ebenso bedenken wie den Sachverhalt, dass es auf wissenschaftliches Wissen auch in Zusammenhängen ankommen wird, von deren künftiger Relevanz wir heute womöglich noch gar keine Ahnung haben.“

FOUNDATIONS AS PLAYERS: WORKING AT THE SCIENCE-POLICY INTERFACES

Das Panel erörterte die Frage, welche Rolle Stiftungen als politisch und finanziell unabhängige Akteure an der Schnittstelle zwischen Wissenschaft und Politik zukommen kann. Ihre doppelte Unabhängigkeit erlaubt es privaten Stiftungen, Projekte zu finanzieren, die andere Akteure aufgrund von politischen oder finanziellen Zwängen nicht fördern.

Gleichzeitig stehen sie bei einem Engagement im Bereich der wissenschaftlichen Politikberatung vor der Herausforderung, ihre Glaubwürdigkeit in beiden Bereichen, der Wissenschaft und der Politik, zu erhalten. Dabei müssen sie sich der Reputationsrisiken bewusst sein. Diese Risiken lassen sich vermindern, wenn Stiftungen wissenschaftliche Politikberatung nicht als Privilegierung eines konkreten Handlungswegs organisieren, sondern die Implikationen politischer Handlungsalternativen wissenschaftlich bewerten.

So können Stiftungen die öffentliche Debatte bereichern und zur Vielfalt von Lösungsansätzen beitragen. Entscheidend für den Erfolg ist dabei zumeist ein langfristiges und systematisches Engagement. Darüber hinaus können Stiftungen dazu beitragen, wissenschaftlichen Erkenntnissen in der Politik zu mehr Gehör zu verhelfen, indem sie durch die Schaffung von Foren den Austausch und den Dialog zwischen Wissenschaft und Politik unterstützen.

The panel addressed the question of which role foundations can play at the science-policy interface as politically and financially independent actors. This dual independence allows private foundations to finance projects which other actors cannot due to political or financial constraints.

At the same time, they face the challenge when engaging in the area of scientific policy advice of how to maintain their credibility in both sectors, science and policy. In this context they must be aware of the risks to their reputation. These risks can be reduced if foundations scientifically assess the implications of alternative courses of political action rather than organizing their scientific policy advice in such a way as to give preference to one specific course of action.

In this way, foundations can enrich public debate and contribute to the diversity of possible solutions. The key to success here tends to be long-term and systematic engagement. In addition, foundations can help ensure that greater political attention is paid to scientific findings by creating forums to support exchange and dialogue between science and policy.

Martin Ahbe

"The European Commission could see foundations playing a stronger role at the interfaces of science and policy in various ways. One particular way would be to support new forms of the participation of citizens in the process of democratic dialogue in order to address the currently wide-spread disconnect of citizens from national as well as European policies."

Helmut Anheier

"Large foundations should concentrate only on what others are unable to do. They should not think of themselves as substitutes for government funding, nor as substitutes for corporate funding. Foundations should concentrate on what only they are capable of doing."

"Foundations can step in and give innovative impetus to science."

Paul Brest

"A foundation that uses empirical research to support advocacy positions endangers its neutrality in supporting research."

James Wilsdon

"In the realm between science and policy, foundations are amongst the only free and capable players because they have independent resources to initiate honest discussions about choices and tensions."


MoyPark

Am Abend des ersten Konferenztages berichtete Klaus Töpfer von seinen Erfahrungen des Zusammenspiels von Politik und Wissenschaft, bevor gemeinsam der 4:0-Sieg der Fußball-Nationalelf gegen Portugal bejubelt wurde.

In the evening of the first day of the conference, Klaus Töpfer reported on his experiences of the interplay between politics and science before everyone got together to celebrate Germany's 4:0 victory over Portugal at the World Cup 2014.

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