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Building the Foundations for Scientific Advice in the International Context

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TODAY’S global society has an unprecedented need for proper and reliable scientific advice. That is because the contemporary world is facing a variety of issues—climate change, energy crises, food security, epidemics—in which science, technology, and society are tightly intertwined. To address these issues, appropriate mechanisms that bridge science and policy making must be established. At the same time, one must recognize that the globalization of the political economy in the past few decades has changed the modality of national borders in every aspect. As a result of these changes, scientific enterprise and relevant socioeconomic activities as well as public policies may have consequences on all parts of the world.¹ Thus, scientific advisory systems today need to effectively function not only within individual countries but also in the international context.

Some academic studies have addressed how science should be interlinked with policy and society in the global context. Based on the case of international

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chlorofluorocarbons regulation, political scientist Peter Haas has proposed the “epistemic communities” model, in which a group of scientists with a shared goal work together to provide expert knowledge and perspectives for helping politicians reach politically difficult agreements. According to this model, by utilizing the epistemic authority and value neutrality of science,² science can inform political decisions at the international level from a transcendental standpoint.

However, scholars of science and technology studies have pointed out that scientific advice in reality is not necessarily either objective or value neutral, which hinders scientific advice in serving as the “silver bullet” in national or international normative conflicts.³ Additionally, many policy issues—which physicist Alvin M. Weinberg labels areas of “trans-science”—cannot be approached solely from scientific viewpoints. These “trans-science” issues require integrating scientific and political perspectives, an especially challenging prospect at the national and international levels because of barriers to cooperation between scientific and political communities such as biases in the interpretation and use of evidence.⁴

Such realities highlight the complexity of scientific advice in an international context. Scientists and other stakeholders from many countries—with their different scientific, political, and cultural traditions—must work together to produce scientific advice that can have far-reaching global consequences. And yet well-established mechanisms for international cooperation and collaboration in this field do not exist. It was only in the past few years that earnest efforts to even discuss the issue of scientific advice in the global policy arena were initiated.

This article will explore possible strategies for building sound foundations for scientific advice in international contexts. The article first presents examples of several scientific advisory systems being deployed at the national, regional, and international levels and then focuses on existing international scientific advisory systems, specifically exploring their historical backgrounds and recent endeavors to address the complexities of scientific advice at an international level. Finally, there is a discussion concerning how international scientific advisory systems could be adapted to new global realities—strengthening the link between scientific advice and policy making, understanding cultural and historical differences among nations, and moving toward a “system of systems” to augment collaboration between international advisory bodies.

Diversity of National and International Scientific Advisory Bodies

Today, there is a diverse array of institutions that can be referred to as scientific advisory bodies, either operating to provide scientific advice to national authorities or at an international level. Some emphasize “policy for science,” and others emphasize “science for policy.” While not meant to be an exhaustive survey, the following categories reflect the diversity of scientific advisory bodies associated with the government and those that exist outside of the government.

Governmental Institutions at the National Level

National scientific advisory bodies usually deal with domestic policy issues, but they are often connected to policy making in the international arena. Their advice can affect other nations' policies as well as broader discussions in the international community. Moreover, the scientific knowledge on which advice is based is often drawn from the best sources, which can be anywhere in the world. In this sense, national advisory bodies can contribute to and be informed by international science advice.

Chief Scientific Advisors: The chief scientific advisor (CSA), particularly to presidents or prime ministers, is one of the most prominent institutions providing scientific advice to national governments. In some countries, the CSA provides an essential link between the government and the scientific community. For example, the United Kingdom has a full-time government chief scientific advisor (GCSA), who directs the Government Office for Science and has full authority to directly advise the prime minister and the cabinet on issues related to science and technology in national and international contexts. For example, after the 2011 Fukushima nuclear disaster, Sir John Beddington, GCSA at the time, promptly conducted a risk assessment and provided advice to British people living in Japan through the British Embassy in Tokyo that not only supported British citizens but was also beneficial to the Japanese government and Anglo-Japanese diplomatic relations.^{5, 6} The UK also utilizes externally appointed CSAs, typically academics, at the ministry level. The GCSA, which is responsible for ensuring the quality of scientific advice throughout the government, chairs the Chief Scientific Advisors Committee that is comprised of CSAs of various government departments.

The United States has the president's science advisor, who is often conferred the title of assistant to the president for science and technology. This person directs the Office of Science and Technology Policy and provides the president with advice on policy making based on scientific evidence ("science for policy") as well as science and technology budgets and coordination ("policy for science"), focusing on both domestic and international affairs. The United States also employs some science advisors or chief scientists at the cabinet level, such as one to the U.S. secretary of state. Both the UK and the United States also employ advisory groups comprising independent scientists, the Council for Science and Technology (in the UK, chaired by the GCSA), and the President's Council of Advisors on Science and Technology (in the United States, co-chaired by the president's science advisor).

Other countries—such as Ireland and several Commonwealth members such as Australia, India, Malaysia, and New Zealand—have CSAs to the government or the prime minister, but with slightly different names and functions. Many countries, including China, France, Germany, Italy, and Japan, do not have CSAs. There is no easy explanation as to why certain countries have CSAs and others

do not, but complex cultural and historical factors have apparently played roles in these decisions.

Government Advisory Committees: In almost all countries, advisory committees set up by government agencies are major sources of scientific advice. Government advisory committees are typically made up of experts from universities and industry and representatives of citizens' groups, NGOs, the media, and sometimes even interest groups. In this sense, government advisory committees usually do not offer purely scientific viewpoints but present views in which scientific and other perspectives are integrated.

In the United States, about a thousand advisory committees exist at the federal level, the operation of which is regulated by the Federal Advisory Committee Act and associated regulations. Japan also has several thousand government advisory committees, some of which are very formal while others are informal or even ad hoc. Sometimes the advice given by those bodies is advanced by their government to the international community in fields such as global environment, international standards, and public health.

Nongovernmental Institutions at the National Level

Some governments also rely on nongovernmental institutions as part of their formal or informal science advisory systems at the national level, particularly when a national scientific community is primarily in the nongovernmental sector. These national nongovernmental institutions are sometimes concerned with the international dimension of scientific advice. For example, some professional scientific societies have an international membership, and some academies participate in making recommendations on international issues to regional or international governmental institutions or provide advice on the national implications of international issues.

Academies and Associations: Academies, which are usually collectives of accomplished scientists and represent academic voices, can be key scientific advisory organizations in some countries. The formal role of the academy in the overall scientific advisory system differs from one country to another. For instance, the charter of the U.S. National Academy of Sciences, signed by President Abraham Lincoln in 1863, defined its mission as "providing independent, objective advice to the nation on matters related to science and technology."⁷ Today, the National Academy, through its National Research Council, annually publishes hundreds of high-quality, trusted reports that are used by the federal government for policy making.

In Japan, the Science Council of Japan represents Japanese academics and also provides scientific input to the government through published proposals. However, its scientific advisory function is not strong, partly because it does not have a solid

support staff and budget and also because government ministries tend to rely on their own advisory committees.

Private and semi-public think tanks and nonprofit organizations are also important sources of scientific advice. In the United States, for example, the American Association for the Advancement of Science (publisher of *Science & Diplomacy*) occasionally issues statements and comments on matters related to science and technology. The Brazilian Society for the Advancement of Science has a formal seat on several governmental councils and commissions, primarily in areas of policy for science, such as Brazil at Council for Science and Technology.

Disciplinary scientific societies generally play only modest roles involving scientific advice at the present, with the exception of some that are involved in policies specific to their particular disciplines, such as the funding of particular scientific facilities. More diverse academic societies could actively make influential policy proposals and recommendations.

Governmental Institutions at the Regional and International Levels

Regional Bodies: The European Union (EU) probably has the most developed regional-level scientific advisory system. The European Commission's Directorate-General for Research and Innovation formulates science and technology policy with help from advisory organizations. The European Research and Innovation Area Board is the most salient advisory organization, delivering reports before important programs are designed. The EU's Joint Research Centre (JRC) provides scientific advice through research in its seven institutes to support a wide range of EU policies and regulations.

In 2012, Anne Glover, former chief scientific advisor for Scotland, was appointed the first chief scientific advisor to the president of the European Commission (EC). Similar to a GCSA, she provides guidance for policy making on the basis of scientific evidence. In addition to directly advising the EC president, she heads the Science and Technology Advisory Council, an unofficial advisory body established in February 2013.⁸ The CSA is supported by a dedicated secretariat team as well as the JRC.

In addition, regional networks of CSAs have taken shape in recent years. The European Science Advisers' Forum, where CSAs of the European region exchange experiences and good practices and collaborate in emergency situations, started in 2014. A similar forum among Asia-Pacific Economic Cooperation nations was started in 2013.

International Organizations: International organizations, such as the United Nations (UN) and the Organisation for Economic Co-operation and Development (OECD), also have policy advisory functions for various domains, including

science and technology, as do specialized technical agencies such as the World Health Organization (WHO) and the World Meteorological Organization (WMO).

In September 2013, the Scientific Advisory Board for the secretary-general of the UN was created at the request of Secretary-General Ban Ki-moon. The board is expected to advise on issues related to the interface between science and policy, in particular those related to sustainable development.⁹

As for the OECD, the Global Science Forum is set up as a subcommittee of the Committee for Scientific and Technological Policy (CSTP). It functions as a forum for consultation among government officials and scientists from all over the world to formulate proposals on important issues regarding science and technology, such as international collaboration on large-scale research facilities.

Nongovernmental Institutions at the Regional and International Levels

Regional Academies: At the regional level, the European Academies Science Advisory Council provides scientific advice to European policy makers. The council formulates scientific advice through collaboration with the national science academies of EU member states, which created it. It produces several reports and statements per year, in three major fields: energy, biosciences, and environment.

While other regional academies, such as the Science Council of Asia, the Network of African Science Academies, and the Inter-American Network of Academies of Sciences exist, these bodies have not regarded scientific advice as their mission.

Associations of Academies: The International Council for Science (ICSU) is a network of national academies and international scientific unions pursuing the promotion of science for society. In its latest *Strategic Plan*, the council sets scientific advice as one of its three major goals, “to ensure that science is integrated into policy development at the international and national level and that relevant policies take into account both scientific knowledge and the needs of science.”¹⁰

Two organizations similar to ICSU are the InterAcademy Panel (IAP) and the InterAcademy Council (IAC) which are both multinational networks of academies. One of the recent contributions of IAC to the global community was its review of the Intergovernmental Panel on Climate Change (IPCC). When the reliability of the IPCC’s fourth Assessment Report was put into question on a global scale in the “Climategate” controversy, the UN and IPCC in March 2010 asked IAC to conduct “a thorough, independent review of the processes and procedures” of IPCC’s activities. IAC completed the review in August 2010 and published a report, establishing an authoritative voice of experts from around the world.¹¹ This case clearly shows the growing importance of international scientific advisory bodies.

Emergence and Evolution of International Scientific Advice

We have now seen several categories of scientific advisory bodies in the world, but the real picture is much more complex, especially at the international level. To grasp a more nuanced picture of the international scientific advisory bodies, it is helpful to understand how they have arisen and evolved. Such historical discussion will be helpful for envisioning the future of international scientific advice, too.

The international scientific advisory body with the longest history is ICSU. Its precursor, the International Association of Academies, was established in 1899. In 1919, that was replaced by the International Research Council, which evolved into ICSU in 1931. However, the main mission of ICSU in those days was not scientific advice but international scientific liaison and cooperation.¹²

After World War II, ICSU came to work in cooperation with the UN Educational, Scientific and Cultural Organization (UNESCO), which was established in 1946. ICSU benefited from UNESCO's financial support and political connection to the UN, while UNESCO capitalized on ICSU's extensive network of the international community of scientists.¹³

ICSU's function began to expand from "diplomacy for science" to "science for diplomacy" in the 1950s and 1960s. In 1958, it created the Scientific Committee on Antarctic Research, which was mandated to provide scientific advice on conservation and management of the Antarctic oceans. ICSU's scientific advisory function expanded most dramatically in the late 1960s with the rise of the environmental movement. In 1969, ICSU created the Scientific Committee on Problems of the Environment, with the mandates of planning and conducting relevant research and providing unbiased scientific advice to governments. Ever since, scientists and policy makers all over the world have increasingly recognized an acute need for a mechanism that links scientific expertise with policy making.¹⁴

As global climate change and other global challenges became a concern of the international community, other international scientific advisory bodies began to emerge. One influential international body, the IPCC, was established by the UN Environment Programme and the WMO in 1988. Its assessment reports, published every several years, contain only the results of scientific analysis and assessment, not recommendations.¹⁵ Nevertheless, the reports have exerted powerful impacts on the policies of international organizations and national governments. The IPCC demonstrates an important boundary organization bridging international politics and science.

A similar international mechanism, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was established in 2012 to strengthen the science-policy interface in the field of biodiversity. Still other international bodies emerged for the purpose of delivering scientific advice on specific domains. The Third World Academy of Sciences (now the World Academy of Sciences) was established in 1983 and became a program unit of UNESCO in

1991. OECD created the Megascience Forum in 1992 with the mandate to coordinate large-scale research projects. It was renamed the Global Science Forum (GSF) in 1999 to deal with wider issues concerning science and technology policy.

In 2000, a new international body for scientific advice, IAC, came into being. IAC closely works with its parent organization, IAP, as well as the InterAcademy Medical Panel, the International Council of Academies of Engineering and Technological Sciences, and ICSU. IAC has contributed to the international community by, for example, issuing a report on capacity building in science and technology in the developing world in 2004.¹⁶

Recently, funding agencies formed their own global network. In May 2012, about fifty funding agencies met for the first time and declared the establishment of the Global Research Council (GRC). While not a scientific advisory organization per se, GRC has issued statements at its annual meetings on such themes as research integrity and scientific peer review.

Thus, the number of international scientific advisory bodies has been growing steadily since World War II. This is quite natural, considering that the globalization of socioeconomic activities has accelerated during the past several decades and that the relationships among science, technology, and society have become fraught with more and more complexity and uncertainties. Such a trend is attested by the “Declaration on Science and the Use of Scientific Knowledge” adopted by the World Conference on Science (now the World Science Forum) jointly organized by UNESCO and ICSU in 1999. In addition to the customary “Science for Knowledge,” it stressed the importance of “Science in Society, Science for Society.”¹⁷

Current Trends in Discussion of International Science Advice

International scientific advice did not emerge as an issue of primary importance in the global community until 2000. For example, even though in the mid-1990s, ICSU was aware of the complexity of issues pertaining to scientific advice, and its external assessment panel published a report in 1996 calling for the strengthening of ICSU’s scientific advisory capacity, its recommendations were not adequately acted upon.¹⁸ Foreseeing a growing demand for scientific advice from national governments and international organizations, the report specifically suggested a need to maintain certain procedures to secure the reputation of ICSU as a source of sound, reliable scientific advice.

Then in 2001, prompted by controversies surrounding the Bovine Spongiform Encephalopathy outbreak and genetically modified foods, the EC addressed problems concerning scientific advice in “European Governance: A White Paper.”¹⁹ The following year, EC published principles and guidelines that the commission should follow in using scientific knowledge for policy making.²⁰ In 2005, the IAC also set up its own procedures for the provision of scientific advice to other entities.

In the meantime, some academic studies on the international comparison of scientific advice produced crucial insights. German environmental sociologist Ortwin Renn identified and characterized fundamentally different mechanisms and premises of scientific advisory systems in some nations.²¹ Sheila Jasanoff, an American scholar of science and technology studies, showed that scientific advisory systems in the United States, the UK, and Germany reflect these countries' distinct societies and cultures.²² A group of researchers drafted a report for the EC, comparing the scientific advisory systems of more than twenty countries and highlighting the transparency/openness and independent advisory processes as critical elements of good practice.²³

It was only in the past few years that international discussions on scientific advice gained momentum in the global policy arena. In September 2012, the IAC issued a report on research integrity and scientific responsibility in the context of today's globalized world. The report laid out a scheme for research ethics as well as one for scientists' communications with policy makers and the public.²⁴ In April 2013, OECD's GSF created an expert group to discuss the responsibility of scientific advisors. The group's report will be presented at the OECD's CSTP's ministerial meeting in 2015. In addition, in October 2013 the UN created the Scientific Advisory Board for its secretary-general. The board, consisting of twenty-six leading scientists, held its first meeting in Berlin in January 2014 and started working toward the goal of reflecting scientific expertise on policies for sustainable development and other UN priorities.

ICSU has also begun promoting international dialogues on scientific advice. It held the first global meeting of high-level science advisors in August 2014 in Auckland, New Zealand. The meeting was hosted and chaired by Peter Gluckman, chief science advisor to the prime minister of New Zealand.²⁵ There have been more limited global meetings of science advisors, for example, the informal and unofficial Carnegie Group of Science Advisors to Presidents and Prime Ministers that originated in 1991 from G-8 economies. But the ICSU meeting was a landmark event in that it enabled senior science advisors from all over the world to explore best practices for implementing science advice. A significant portion of the discussion focused on developing an approach to international science advice, considering such questions as: What can be achieved multinationally that could not be done by individual countries? What is the place of a multinational approach for science advice? What issues necessitate multilateral thinking? What are the threads of a common approach to providing multinational advice to international bodies? In addition, the agenda included discussion on the feasibility of establishing an enduring global network of science advisors. Such a rapid unfolding of related international activities clearly indicates the emergence of a worldwide conviction that sound and effective scientific advice is critical for many nations and the international community in tackling today's problems.

Challenges and Recommendations for International Advice

Filling the Policy-Science Gap

Certain challenges have arisen in conjunction with the growing international recognition of the need for a mechanism that effectively links science and policy making: specifically, the task of bridging dual gaps between science and politics and between nation-state systems and global agendas. These challenges must be met in order to lay a solid foundation for scientific advice in the globalized world—an objective that can be realized through the collaborative efforts of stakeholders in all countries.

Most countries are in the midst of examining strategies by which science and policy can be linked. For example, the Netherlands and Japan have recently been considering setting up CSA positions. Smooth cooperation between scientific advisors and policy makers is always difficult to attain.

Trust appears to be the most important foundation for effective scientific advice among scientists, policy makers, and the public. A key means to achieve such trust would be to establish codes of conduct concerning scientific advice, thereby defining the roles and responsibilities of scientific advisors and policy makers. Several countries, including the United States and the UK, have formulated such codes of conduct, which function as instruments to certify scientific independence and objectivity, locate and clarify responsibilities, handle uncertainty, and assemble the diverse perspectives of scientific communities.²⁶ Similar codes of conduct could be established and steadily implemented elsewhere in the world and at the international level.

Accommodating Cultural and Historical Differences among Nations

As the world gets ever smaller, nations must harmonize and synthesize their policies. To this end, building a common ground for science-based policy making is a crucial task, even though particularities of individual nations should be duly respected.

On October 22 and 23, 2013, in Tokyo, the OECD's GSF in conjunction with the Japanese Ministry of Education, Culture, Sports, Science and Technology, the National Graduate Institute for Policy Studies, and the Center for Research and Development Strategy of the Japan Science and Technology Agency organized the Workshop on Scientific Advice for Policy Making and Consequences for the Role and Responsibility of Scientists. The workshop drew an extensive participation of scientists and administrators from both OECD member and non-member countries. One of the most attention-worthy issues raised during the workshop was the need to remember the fact that science in each country is embedded in the country's politics, culture, and history. There are countries that became democratic only recently, maintain strong religious conventions, or have various other particularities. The place of science in such societies can be very different

from that in Western societies, where the tradition of democracy as well as that of science has been in place for centuries.

Yet science is essentially borderless, and it has played a function to complement the official diplomatic relations. For example, scientific exchanges between the United States and Japan were instrumental in establishing diplomatic relations between the two countries after World War II. It is important for the global diplomatic community to recognize that science has unique roles and functions by sharing historical experience like this.

Although the importance of international scientific advisory systems is apparently growing, it is not reasonable to try to apply a certain set of standards to all countries without any regard to each entity's political, cultural, and historical background. Participants in the workshop pointed out that a one-size-fits-all model would not work for scientific advice. The design of international scientific advisory systems should not presuppose a homogenous state of consciousness and readiness for scientific advice around the world but needs to take into consideration those countries where the connection between science and policy making is not well developed. Ideally, international scientific advisory systems can enhance and supplement scientific advisory systems of those countries.

Building Collaboration among International Bodies

The current international landscape of scientific advisory systems is extremely complex. Each nation embraces its own system, which has been shaped historically and is embedded in the nation's political and cultural contexts. Efforts for international dialogue on scientific advice have just begun, and no one knows yet whether, how, and to what extent those national systems can ever be harmonized. Meanwhile, the number of international bodies providing scientific advice has been growing, as the international community faces more and more global problems. A full-scale global effort is now needed to make all those national and international systems work more effectively as a whole.

Obviously, expanding dialogue among countries will be beneficial to scientific advice in the international context. Even though each country will adopt its own scientific advisory mechanisms, it can learn from another's experience. More occasions for international discussion, like that in OECD's GSF, should be arranged. Through such discussion of scientific advice, which all nations in the world can refer to but need not necessarily conform to, good practices might emerge.

Just promoting dialogue and discussion would not be sufficient, however. For scientific advice to work effectively in today's globalized world, it would be necessary to design a scheme by which many existing international organizations concerned with scientific advice can collectively realize their full potential. This scheme should aim at forming a reasonably flexible, yet effective, "system of systems" for scientific advice in the world.

In working toward such a goal, all relevant international bodies should first pursue mutual understanding and recognition. Based on that, organizations such as ICSU, IAC, IAP, UNESCO, GRC, and OECD's GSF should, for example, create a joint vision, or agenda, of scientific advice to be drafted. They should also closely work with organizations providing scientific advice in specific fields, such as IPCC, IPBES, WMO, and WHO, by proposing procedures to maintain the quality and integrity of those organizations' scientific advice.

Finally, constructing a "system of systems" of international scientific advisory organizations would enable addressing pressing issues that so far have been left behind. Among such issues is assessing the macro transformation of scientific endeavors in the world and identifying ways to strengthen societal values of science. Recent changes in the ways in which scientific work is conducted have been rapid and enormous, as the input of resources into scientific research has expanded worldwide. The amount of scientific information produced each year is greatly expanding, competition among universities as well as researchers is intensifying, and the commercialization of scientific activities is escalating. That would then transform the values of science itself, attenuate the pool of reliable researchers and scientific knowledge, and undermine the credibility of scientific advice, destroying a critical infrastructure of contemporary society. Such issues can be an important agenda for a "system of systems" for scientific advice in the world.

International efforts to build sound, effective scientific advisory systems are gaining more momentum. The ICSU, IAP, and OECD's GSF, among others, are not only engaged in scientific advising, but also in discussing and suggesting ways for other national and international bodies to make scientific advice more effective. Such activities are just beginning to inform the top policy makers of the world, as in the cases of the first global meeting of high-level science advisors in August 2014, the OECD's CSTP's ministerial meeting in September 2015, and the newly formed Scientific Advisory Board for the UN secretary-general.

The role of science in policy making is expected to steadily expand in the future. All countries as well as the international community will face an increasing number of problems in which scientific and technological factors interact with social, economic, and political considerations. And, as always, the time and the financial and human resources that can be devoted to addressing such problems are limited. Thus, all stakeholders will need to share their challenges, interests, and insights with the entire international community and engage in mutual dialogue and coordination to ensure that science serves as a solid foundation for the world of the future.²⁷ **SD**

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26. As to the United States, see, for example, John P. Holdren, “Memorandum for the Heads of Executive Departments and Agencies, Subject: Scientific Integrity,” The Office of Science and Technology Policy, December, 17, 2010, <http://www.whitehouse.gov/sites/default/files/microsites/ostp/scientific-integrity-memo-12172010.pdf>. As to the UK, see *The Government Chief Scientific Advisor’s Guidelines on the Use of Scientific and Engineering Advice in Policy Making*, (London, Government Office for Science, Department for Business, Innovation and Skills, June 2010), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293037/10-669-gcsa-guidelines-scientific-engineering-advice-policy-making.pdf, and “Principles of Scientific Advice to Government,” Department for Business, Innovation and Skills, March 24, 2010, <https://www.gov.uk/government/publications/scientific-advice-to-government-principles/principles-of-scientific-advice-to-government>.
27. Tateo Arimoto and Yasushi Sato, “Rebuilding Public Trust in Science for Policy Making,” *Science* 337 (September 7, 2012): 1176–77, <http://www.sciencemag.org/content/337/6099/1176.summary>.