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Science and democracy

Science and democracy in a globalizing world: challenges for American foreign policy

Clark A Miller

The ideals of reason and freedom have long occupied central positions in the diplomatic imagination of the United States, leading US foreign policy to emphasize science and democracy as key elements in the fashioning of global order in the 20th century. At the beginning of the 21st century, however, the combination of science and democracy seems an increasingly ambivalent source of authority and inspiration. Advances in science and technology threaten to erode the self-determination of democratic societies, while new calls for the democratization of global governance raise difficult questions regarding the power and legitimacy of science and other forms of expertise in international institutions. This paper seeks to open a new dialogue on the conceptual underpinnings of US foreign policy and the potential for fashioning new commitments to reason and freedom that can strengthen both democratic governance and the management of rapid scientific and technological change in contemporary world affairs.

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OVER THE COURSE of the 20th century, United States acquired an increasingly central position in world affairs. As power shifted, US conceptions of world order, and strategies for achieving it, displaced those of previous eras, leading to key changes in the landscape of international relations, including the creation of the League of Nations and the United Nations (UN), the decolonization of Africa and South and Southeast Asia, and Cold War policies of containment. Fundamental to these changes in diplomatic practice and international organization was the application of American ideas of science and democracy as principles for ordering international relations.[1]

Of the two, democracy is the more well known to foreign policy observers (Smith, 1994). American opposition to decolonization focused around ideas of the self-determination of peoples expressed on the world stage by Woodrow Wilson. Encompassing the 20th century, American occupation of the Philippines, Cuba, Germany, Japan, Afghanistan, and Iraq have been grounded, ideologically, on a commitment to bringing democracy to countries previously ruled by (colonial or imperial) authoritarian governments. Multilateralism and its introduction into the institutional arrangements of the League of Nations and the UN offer further examples of elements of democratic liberalism incorporated by Americans into the conduct and organization of global diplomacy (Ruggie, 1993; Burley, 1993).

Perhaps less well known, but certainly no less important, science has also long occupied a prominent position in American diplomatic and political imagination.[2] Scientific and technological expertise became particularly important at the close of World War II, when Americans turned to scientific laboratories as

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"our first line of defense" (Patterson 1945, cited in Dennis 1994). Scientific and technological superiority became instrumental to US military and economic power. Apparent closures of scientific and technological gaps raised deep security concerns for the US, from the first Soviet test of a hydrogen bomb and the launch of Sputnik in the 1950s, to Japanese industrial expansion in the 1980s and Iraq's pursuit of nuclear and biological weapons in the 1990s.

American foreign policy also turned frequently to science and technology in its efforts to stabilize societies in transition from colonial rule and to facilitate productive cooperation among the rapidly expanding community of nations. The result was an explosion in the number of experts participating in international diplomacy, in the creation of expert agencies affiliated with the UN, such as the World Health Organization, the World Meteorological Organization, and the International Monetary Fund, and in the deployment of technical assistance programs aiming to bring the fruits of American science and technology to peoples from China and Egypt to Peru and Indonesia (Miller, 2001a; Moon, 1998; Jacobson and Stein, 1966).

Much as Ezrahi (1990) observed that western polities had used "scientific knowledge and skills not so much to enhance the instrumental effectiveness of democratic governments as to ideologically defend and legitimate uniquely liberal–democratic modes of public action," so too did American foreign policy officials adapt science and technology in similar ways in "presenting, defending, and criticizing the uses of political power" (Ezrahi 1990, page 1) in international governance. From the creation of programs for the 'peaceful uses' of atomic energy to the formation of the Intergovernmental Panel for Climate Change, Americans have seen science and technology as key instruments in their efforts to establish international norms of behavior, to formulate global policies, and to end international conflict.

At the dawn of the 21st century, however, both science and democracy seem increasingly ambivalent sources of authority and inspiration for American foreign policy. Simplistic ideas of technological development in the Third World have foundered. Events in Yugoslavia, Afghanistan, and Iraq serve to highlight the tremendous difficulties of building democratic nations. Worldwide expansion and dissemination of scientific and technological research has raised the specter of weapons of mass destruction in the hands of extremist networks. New technologies of communication and transportation have undermined the idea of self-determination, especially for the many who now see America as a hegemonic power able to project its force, products, and ideas anywhere it wishes.

My goal in this essay is to lay out an agenda for research to explore the challenges of continuing to rely on science and democracy as pillars for the organization of world affairs. Reason and freedom remain two of the most prominent philosophical traditions that command assent and authority across a wide spectrum of political cultures. As such, they represent at least potential foci around which to forge new concepts, practices, and institutions of governance for the planet as a whole. Yet rapid global change in knowledge, social relations, economic markets, technological capabilities, and environmental degradation call into question the ability of both science and democracy to transcend the ideological rifts that divide global society.

To address these concerns, I believe we need to delve in depth into three interrelated issues: how American and other countries' foreign policies have intertwined science and democracy in efforts to secure international order, and the implications of past discourses and programs for the contemporary landscape of world affairs; how continuing advances in science and technology intersect with the ability of communities around the world to participate in decisions about the forces that shape their lives; and, finally, how experiments in intertwining expert and democratic elements in contemporary international organizations can inform efforts to build new forms of global governance, in the future, that can command widespread legitimacy among all the citizens of global society.

Visions of world progress

Visions of technological progress have profoundly shaped western democracy and continue to do so today (Smith and Marx, 1994). Colonial historians have also demonstrated how European visions of science and technology penetrated deeply into the exercise of imperial power in the 19th and early 20th centuries (Adas, 1988; Storey, 1997).

What has been less well recognized, except perhaps in critical studies of development (see, for instance, Sachs, 1999; Scott, 1998; Ferguson, 1990), are the ways in which specifically American ideas of science and democracy have influenced broad programmatic agendas for ordering world affairs in the 20th century (Miller, 2001a; on democracy, by itself, as a guiding principle of American diplomacy, see Smith, 1994). Historically, how have Americans and others viewed the connections among science, democracy, and world order? How have diplomatic institutions such

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as the League of Nations and the UN, and specific national agencies, such as the US Agency for International Development, institutionalized this relationship in their programs and activities? Where, in turn, are ideas about science and democracy leading global society today?

One way to think about these questions is to explore the ideas that have shaped US diplomatic leadership. Throughout the 20th century, American Presidents have consistently spoken about the need to stabilize relationships among the world's nations and the role that both science and democracy can play in helping secure world order.

Some of the central elements of these ideas are captured in the text boxes. Although the quotes are lengthy, they are worth considering in depth as exemplars of how narratives of progress weave together ideas of science and democracy. They are taken, not surprisingly, from periods of war and conflict, in which America's leaders have felt it necessary to commit the United States to an active role in world society and have seen science and democracy as perhaps the two central offerings the country could make to global peace and prosperity. It is also worth noting the subtle differences among the texts in just precisely how they link science and democracy.

The first quote is taken from Woodrow Wilson's address to Congress in January, 1917, as America geared up to declare war on Germany in World War I. Wilson's purpose was to lay out the principles on which a just postwar order might be founded (see Box 1). Soon thereafter, these principles became the foundation for Wilson's negotiating strategy at the peace settlement and his proposal for a League of Nations. Wilson's focus is on democracy, and particularly on the idea of self-determination:

> "No peace can last, or ought to last, which does not recognize and accept the principle that governments derive all their just powers from the consent of the governed, and that no right anywhere exists to hand peoples about from sovereignty to sovereignty as if they were property."

Yet it is also worth noting that Wilson highlights the freedom to determine both "its own polity" and "its own way of development." For Wilson, a key aspect of freedom was the right of a people to set its own path to progress.

Box 1. Woodrow Wilson, speech to Congress, 1917

No peace can last, or ought to last, which does not recognize and accept the principle that governments derive all their just powers from the consent of the governed, and that no right anywhere exists to hand peoples about from sovereignty to sovereignty as if they were property. I take it for granted … that henceforth inviolable security of life, of worship, and of industrial and social development should be guaranteed to all peoples who have lived hitherto under the power of government devoted to a faith and purpose hostile to their own.

… I would fain believe that I am speaking for the silent mass of mankind everywhere who have as yet had no place or opportunity to speak their real hearts out. … no nation should seek to extend its polity over any other nation or people, but every people should be left free to determine its own polity, its own way of development, unhindered, unthreatened, unafraid, the little along with the great and powerful.

Three decades later, in the aftermath of the Second World War and in the midst of the rapid escalation of the Cold War between the United States and the Soviet Union, Harry S Truman returned to a similar theme in his inaugural address in January 1949 (see Box 2). Democracy, Truman suggested, was essential to the construction of a secure and prosperous world order, but must also be combined with a new kind of program, one that would alleviate the impoverished conditions of the lives of people around the world using American know-how, helping stabilize countries facing internal civil strife and "communist interference."

Built on the model of the Marshall Program, this initiative would become known as the Point IV program, for its position as the fourth major point of Truman's address; it would provide billions of dollars in technical assistance to "underdeveloped areas"; and it would create what would eventually

Box 2. Harry S Truman, inaugural address, January 21. 1949

We must embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas. More than half the people of the world are living in conditions approaching misery. Their food is inadequate. They are victims of disease. Their economic life is primitive and stagnant. Their poverty is a handicap and a threat both to them and to more prosperous areas. …

I believe that we should make available to peace-loving peoples the benefits of our store of technical knowledge in order to help them realize their aspirations for a better life. … The old imperialism — exploitation for foreign profit — has no place in our plans. What we envisage is a program of development based on the concepts of democratic fair dealing. … Democracy alone can supply the vitalizing force to stir the peoples of the world into triumphant action, not only against their human oppressors, but also against their ancient enemies — hunger, misery, and despair.

Box 3. Lyndon B Johnson, April 7, 1965, address at Johns Hopkins University

These countries in Southeast Asia are homes for millions of impoverished people. Each day these people rise at dawn and struggle through until the night to wrestle existence from the soil. They are often wracked by diseases, plagued by hunger, and death comes at the early age of forty. Stability and peace do not come easily in such a land. Neither independence nor human dignity will ever be won through by arms alone. It also requires works of peace.

The American people have helped generously in times past in these works, and now there must be a much more massive effort to improve the life of man in that conflict-torn corner of our world. … The task is nothing less than to enrich the hopes and existence of more than a hundred million people. And there is much to be done. The vast Mekong River can provide food and water and power on a scale to dwarf even our own TVA. The wonders of modern medicine can be spread through villages where thousands die every year from lack of care. Schools can be established to train people in the skills needed to manage the process of development.

… We often say how impressive power is. But I do not find it impressive at all. The guns and the bombs, the rockets and the warships, are all symbols of human failure. They are necessary symbols. They protect what we cherish. But they are witness to human folly. A dam built across a great river is impressive. In the countryside where I was born, where I live, I have seen the night illuminated, and the kitchen warmed, and the home heated, where once the cheerless night and ceaseless cold held sway. And all this happened because electricity came to our area humming along the wires of the REA. Electrification of the countryside — yes, that too is impressive. A rich harvest in a hungry land is impressive. The sight of healthy children in a classroom is impressive.

become the US Agency for International Development. Truman also pushed the UN to conduct substantial programs of technical assistance.

As US technical assistance to developing countries expanded, the US also became deeply involved in the political and military affairs of these regions, especially in East and Southeast Asia. In Vietnam, in particular, the ideology of technological progress acquired a prominent place in American strategies for bringing about an end to the war. First John F Kennedy and later Lyndon B Johnson articulated visions of how technology could return the region to civility and order.

Johnson, especially, drew parallels between New Deal technological utopias in the American South and what America could do for its neighbors on the other side of the planet (see Box 3). By using its technological might, Johnson (1965) argued, America could "enrich the hopes and existence of more than a hundred million people" in "that conflict-torn corner of our world" and so eliminate the need for war and starvation. American scientists agreed. Writing in the *Bulletin of the Atomic Scientists*, Gilbert White (1964, page 351) noted:

> "A peaceful and honorable resolution of the conflict in South Viet-Nam [*sic*] and Laos may be found in a bold plan for land and water development which already unites factions in four nations in Southeast Asia … These four countries, which do not cooperate in anything else, have reached accord on the development of the Lower Mekong Basin."

This series of presidential quotes culminates in an excerpt from a televised address given by George W Bush, March 17, 2003, on the eve of war with Iraq (see Box 4). Bush's logic for war is grounded in the ability of non-democratic forces to use science and technology, in the form of weapons of mass destruction, to disrupt the lives of people everywhere and in the necessity that follows for free peoples to oppose such efforts if they wish to remain free.

While Bush seeks to draw a boundary around weapons of mass destruction as unique disruptors of world order, others make parallel arguments about American technologies, such as the internet, television, and movies, not to mention smart bombs, A-1 Abram tanks, and B-2 stealth bombers, that threaten their own cultural freedom and identity. Bush's logic also draws a deeper connection between science and democracy, raising the suggestion that freedom offers people the chance to "turn the creative gifts of men and women to the pursuits of peace." I read this statement as affirming that free peoples are those that pursue science not for war but to improve the human condition.

What we see in these quotes are four evolving efforts to harness science, technology, and democracy not just to the goals of American foreign policy but to an American vision for global progress and prosperity. Beginning with Wilson, we see a gradual evolution of American attitudes from one in which democracy provides the foundation for a world order in which people can pursue industrialization free

Box 4. George W Bush, televised address, March 17, 2003

The cause of peace requires all free nations to recognize new and undeniable realities. In the 20th century, some chose to appease murderous dictators whose threats were allowed to grow into genocide and global war. In this century, when evil men plot chemical, biological, or nuclear terror, a policy of appeasement could bring destruction of a kind never before seen on this earth. Terrorists and terrorist states do not reveal those threats with fair notice in formal declarations. And responding to such enemies only after they have struck first is not self-defense. It is suicide.

The security of the world requires disarming Saddam Hussein now. As we enforce the just demands of the world, we will also honor the deepest commitments of our country. Unlike Saddam Hussein, we believe the Iraqi people are deserving and capable of human liberty, and when the dictator has departed, they can set an example to all the Middle East of a vital and peaceful and self-governing nation.

The United States with other countries will work to advance liberty and peace in that region. Our goal will not be achieved overnight, but it can come over time. The power and appeal of human liberty is felt in every life and every land, and the greatest power of freedom is to overcome hatred and violence, and turn the creative gifts of men and women to the pursuits of peace. That is the future we choose.

from exploitation and dominance by others, to one in which support for scientific and technological advancement becomes the foundation for the achievement of a world of peaceful, democratic societies (for a mid-century exposition of this latter view, see, for instance, Berkner, 1950), to one in which science and democracy both enhance and threaten each other.

Several major trends underlie this transition. The first is the gradual expansion of "America's Mission" (Smith, 1994) to territories and peoples further and further afield. Wilson's world incorporated primarily Europe and the American colonies of Cuba and the Philippines, and to some degree Latin America. Truman opened US technical assistance programs to a much wider array of nations. By Johnson's Presidency, Americans were actively involved in the lives and welfare of people across the planet, as they remain today.

Another important factor seems to be the Cold War. Both before and after the Cold War, US diplomacy exhibited considerably greater willingness to become openly involved in the political affairs of other countries. During the Cold War, however, a fear of appearing too like the Soviets, in terms of direct political manipulation, led the US to pull back on its pursuit of democratization, as did a sense that powerful right-wing dictators might better resist Communism than weak centrist democracies.

Finally, American ideas of science and technology also changed. Especially during the 1930s and 1940s, the experiences of the Great Depression, New Deal, and World War II led Americans to a revised view of the power of science and technology to undergird social order. Articulated most clearly in Vannevar Bush's now famous *Science: The Endless Frontier* (Bush, 1945), Americans came to view science and technology as the key to economic growth and prosperity, public health, and sufficient food supplies.

Applied abroad, this vision became the centerpiece of a logic that equated scientific and technological development with enhanced economic welfare and greater political stability in the face of communist aggression. Today, however, science and technology are more ambivalent icons of progress, with darker sides, represented by the threat of nuclear holocaust, environmental degradation, and the growing ability of scientists to manipulate fundamental elements of human and non-human biology.

These observations raise a number of important questions about the history of American foreign policy that have not been addressed adequately in scholarly research. How have these broad visions of science, technology, and a liberal world order (whose primary purpose was to sell Americans on a strategy for operating abroad) been articulated in the day-to-day practices of American diplomacy?

How, for example, did Americans incorporate science and technology into the construction of colonial governments in Cuba and the Philippines? How did these experiences, in turn, shape later programs of democratization and technical assistance? Where do the occupations of Japan and Germany after World War II fit into the evolution of American ideas of science and democracy in world order (for a taste, see Yoshikawa and Kauffman (1994))? Likewise, where do the development of nuclear weapons and ballistic missiles fit?

In practical terms, what comprised technical assistance at various points in time, and how did it connect to programs for ordering economic and political life in recipient countries? How, also, did ideas about science and technology shape the agendas, institutionalization, and reception among the world's peoples of the League of Nations and the UN, as well as the later proliferation of multilateral institutions of international governance?

Important questions can also be raised about contemporary programs of democratization and technical assistance. How does the disaggregation of current programs into separate categories of 'technical assistance' and 'democratization' play out on the ground, in practice? How do these bifurcated programs intersect with local understanding of the relationship of knowledge to power? How do different experiences of democratization and technoscientific transformation (often carried out under the aegis of the transition to capitalism and free markets) compare to one another? How might research that recognized the intimate connections among science, technology, and democracy contribute to the theory and practice of managing transitions?

Finally, visions of science, technology, and democracy in international relations also raise questions about the emergence and evolution of global society. Where do global ideas come from (Jasanoff, 2001; Cosgrove, 2001; Takacs, 1996; Miller, forthcoming), and how do they acquire credibility and authority among the diverse cultures that make up the global polity? Where do contemporary ideas of scientific and technological progress derive from, and where are they taking global society? Is it possible to forge new arrangements for linking the pursuit of science and technology to the pursuit of democracy in world affairs?

In the next two sections, I further clarify and expand on these last questions, first with respect to the implications of scientific and technological globalization for the notion of self-determination at the center of current sensibilities about 'making the world safe for democracy,' and second with respect to emerging arrangements for governing the planet as a whole.

Science, technology, and self-determination

The concept of self-determination occupied a central position in 20th century institutions for ordering world affairs and continues to do so today. Building on Wilson's principles, both the League of Nations

and the UN insisted on the rights of nations to self-determination. Especially in the battles over decolonization after World War II and the geopolitics of the Cold War, the language of sovereignty acquired a near stranglehold on the ideological framework of postwar international relations.

Countries emerging from colonial rule, in particular, insisted on complete freedom from political influence from abroad. Self-determination struck a renewed popular nerve in the revolutions in Eastern Europe and the Soviet Union, and notions of self-determination continued through the 1990s to underpin separatist movements in many parts of the world.

Self-determination intersects broadly with science and technology in at least two important ways. On the one hand, many countries, not just industrial democracies, have become committed to scientific and technological progress as a key component of their vision of society, as have many of the development programs operated by multinational institutions such as the International Monetary Fund and World Bank. By freeing the private sector and private individuals to develop and profit from invention (traditionally through the patent system), the argument goes, society can improve itself.

Building on the postwar experiences of first the United States and later Japan and Germany, public-sector support for research and development (R&D) has partnered, and in some cases supplanted, private-sector investment as a source of support for advances in science and technology in the last part of the 20th century. Only at the margins, in terms of public-sector support for civilian technology projects, have small differences emerged among countries in the ideology and practice of government-sponsored R&D. Even in the United States, in which opposition to Government-funded 'industrial policy' has been most vocal, support for public–private partnerships in the form of 'dual use technologies,' 'university research parks,' and entities such as Sematech have grown dramatically (for a discussion of these kinds of organization that sit on the boundaries of science, politics, and industry, see Guston (2000)).

In an era in which direct government subsidies and tariffs have become the subject of intense efforts to eliminate barriers to trade, R&D funding has become one of the few remaining approaches to economic competition that are seen as legitimate in a liberal world order. The upshot of the postwar boom in R&D spending has been a dramatic expansion of scientific knowledge and technological systems, many of which reach quickly and quite deliberately beyond the boundaries of the society in which they originated.[3]

Although many who defend the freedom of scientists to pursue research of their own choosing suggest that societies can resist the products of science if they choose (see, for instance, the quote from Ian Wilmut's *Second Creation* in Box 5), experience over the past 50 years suggests this view is rather naïve. In the second half of the 20th century, communications, travel and transportation, nuclear weapons, ballistic missiles, and numerous other technologies began to challenge the sovereignty of nations and peoples to make decisions for themselves.

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More recently, the world has also faced renewed pressure from the emergence of a new array of policy problems, such as capital market collapse, climate change, and terrorism, that experts paint as global in scope, and the development of new classes of technologies, such as cloning and genetic engineering, that, when combined with free trade principles, seem to raise profound questions about the ability of countries to govern themselves in the face of scientific and technological change originating elsewhere in the world.

Box 5. Ian Wilmut, the inventor of Dolly, published in Second Creation

There is a broader point, perhaps best illustrated by reference to the United States. In the Western world we generally subscribe to the notion of democracy and also tend to support the idea of free enterprise. The philosophy of democracy differs enormously in different parts of the world. In Britain, for example, it tends to mean 'majority rule,' although Britons pay increasing attention to the demands of various minorities. But some, at least, of the founders of the United States saw majority rule in an unsavory light. Much more important, they felt, was personal freedom, the right of an individual to do what he or she wants. Personal liberty remains the guiding light of the U.S. (manifested most grotesquely in the perceived 'right' to carry firearms). Thus it is that people in the U.S. who themselves object to the idea of human cloning are quite likely to defend the rights of people who welcome it. It is always difficult to maintain unpopular laws in democracies. In societies in which personal liberty is perceived effectively to be sacrosanct, it is surely almost impossible.

On the face of things, then, it may seem that human cloning (and, perhaps, from this, germ-line engineering) is very likely to happen: perhaps in the first half of the twenty-first century, if not in the first decade. But it is not inevitable …

The pressures for human cloning are powerful, but although it seems likely that somebody, at some time, will attempt it, we need not assume that it will ever become a common or significant feature of human life. Society does not have to adopt technologies with which it feels uncomfortable, and people have already shown that they are perfectly able to resist what they do not like.

Developing countries appear particularly vulnerable to the impositions of science and technology. In many places in the world, where the state has systematically dismantled civil society, the introduction of new technologies may be difficult to resist. Rumors of field tests of genetically engineered bacteria in South America, unbeknownst to the government and people of the 'host' country, certainly raise questions, as does the history of agricultural modernization projects, such as the Green Revolution (Shiva, 1991). Indeed, in the wake of the events of September 11, 2001, we must not ignore the dark side of scientific and technological mastery and its potential implications.

Although Yaron Ezrahi's *Rubber Bullets* (Ezrahi, 1997) offered hope for a new, more liberal and more democratic Israeli relationship with the Palestinians, the tentative instrumentalism marked by the Israeli Government's decision in 1988 to adopt rubber bullets to measure its use of force against the rock-throwing children of the Intifada seems all but lost in the technological onslaught of suicide bombings and Israeli military offensives of the last year. US and Al Qaeda interventions in Afghanistan demonstrate the power of technologically sophisticated organizations to disrupt the self-determination of entire nations.

Many Indian activists see science and technology today as little more than the coercive tools of the state (Visvanathan, 1997) and the West (Shiva, 1997). Historians and cultural observers remind us that science and technology have also often been used ideologically, as measures of civilization, to justify colonial regimes (Said, 1978; Adas, 1988; Headrick, 1988; 1981). James Scott and Zygmunt Bauman remind us of the devastation that science and technology can bring to people and nature when applied without the constraint of democratic critique and oversight (Scott, 1998; Bauman, 1989).

Even in western democracies, however, recent advances in science and technology have, for some people, called into question citizens' rights to choose their own technological futures (Winner, 1986; Sclove, 1995). Transatlantic debates over bovine growth hormones and genetically modified organisms have centered on the rights of countries to resist the introduction of new technologies into their jurisdiction, in a world increasingly dominated by free-market and free-trade principles, as well as the criteria on which such decisions may be made (for instance, Grove-White *et al*, 1997; Barry, 2001).

Novels such as Michael Crichton's *Prey* prey on growing public fears that corporate secrecy may prevent the public from acquiring adequate knowledge on which, as Wilmut (2001) puts it, "to resist what they do not like," contributing to a growing chorus of calls for reimagining corporate governance in a more transparent, accountable structure (Jasanoff, 2002; Doubleday, 2003).

In short, self-determination seems to many increasingly incompatible with territorially constrained notions of national self-identity and Earth-spanning notions of what matters. The willingness of corporations to take advantage of the patchwork of regulations to pursue scientific and technological research wherever it goes unregulated, alongside people's apparent willingness to cross national borders to seek the products of that research (in health care, for instance, in pursuit of extracts of endangered species, unlicensed pharmaceuticals, and risky medical procedures), undermine the effectiveness of national self-regulation.

Democracy — understood as an institutional form of governance in which people have a say (in some form) in decisions affecting things they care about — may only be possible in the future if it can be expanded to encompass the Earth as a whole. Wilmut's logic seems to suggest this, implicitly hinting at the need to call into being a unified, global society that rejects extreme forms of individual liberalism. Only in this way, he intimates, can some of the more horrific potentials of human cloning and germ line therapy be avoided.

Others have been more explicit, linking advances in science and technology to demands for a new kind of political organization that organizes the Earth as a single polity. The environment, in particular, has been a fruitful arena for arguments that new knowledge demonstrates the limitations of existing political arrangements in global society. In a speech to the Second Climate Conference in 1990, for example, Mostafa Tolba (1991), then Executive Director of the UN Environment Program, all but declared national self-determination dead as a consequence of new scientific understandings of climate change:

> "The sum of research into the science and impacts of climate change makes it clear that nothing less than dramatic reductions in greenhouse gases will stop the inexorable warming of the planet. Nothing short of action that affects every individual on the planet will forestall global catastrophe."

Yaron Ezrahi ends his classic study of S&T in American democracy (Ezrahi, 1990) on a hopeful note. Having rejected meliorism, he argues, the US may well find new ways to reconcile the pursuit of science and technology with the pursuit of freedom and democracy. In the light of America's response to 9/11, and other recent events, I am no longer so sure. Far from a source of liberty, the stability of scientific and technological forms of life serves today as ideological justification for coercive restrictions on freedom — what Ezrahi feared most:

> "The liberal democratic state has been constantly threatened by the anarchistic potential inherent in its commitment to freedom and, perhaps even more, by the periodic anti-democratic reactions, such as the impulse to centralize power, which the fear of anarchism has tended to provoke."

Following 9/11, the need to protect the integrity of the air transportation system, energy production, nuclear power plants, the nation's dams and skyscrapers, the mail sorting and handling system and other technologies deemed essential to modern America has become a major justification for increasing security restrictions at home and, as President Bush indicates in the text cited above, American efforts to reorder the world as a whole.

These observations raise important questions. At a time when, as a consequence of the demise in the mid-1990s of the Office of Technology Assessment, the US lacks even a basic capacity for public assessment of technological systems and their intersections with society, there is a growing need for the United States to be able to assess and evaluate the implications of technological change around the world. Such a capacity is important not just for its own security but perhaps even more importantly for a sense of how scientific and technological developments in the US impact our neighbors around the planet.

Occasional discussions focus on US military technologies and on Hollywood, yet Americans exert power in the world through science and technology in many other fields as well. Understanding the scientific and technological elements of US power will be crucial to navigating the treacherous shoals of global diplomacy in the coming decades.

Expertise and global governance

In the final section, I turn my attention to emerging structures of global governance and how they incorporate expertise and expert knowledge (Miller and Edwards, 2001; see also Jasanoff and Wynne, 1998 for a review of literature in this area). Americans have always been skeptical of subjecting their policies to international scrutiny and approval. Yet, as discussed above, Americans were also responsible for the creation of a novel form of international institution built around scientific and technical expertise, exemplified by the UN Specialized Agencies.

Support for such institutions remains strong in the United States, as was evident in US cooperation with the World Health Organization during the recent SARS outbreak, which occurred during an otherwise low point in US attitudes toward international governance. As the US responds to increasingly complex and interdependent world events, these institutions seem likely to increase further in importance, highlighting the need to understand their structure and activities, as well as their authority and credibility among world publics, not only as historical achievements, but as key elements of emerging global governing arrangements.

Research on the role of expertise in democratic governance, which has received a great deal of attention in recent years, suggests a number of approaches that we might take to exploring this topic. The last decades of the 20th century saw the connection between science and democracy become a major topic of conversation in western societies. In the 1970s and 1980s, growing public controversies over the implementation of environment, health, and safety laws — what Ulrich Beck (1992) would later term the emergence of a risk society — had frequently given the impression that science and democracy were inimical to one another.

Some observers saw science as the key to better decisions; others saw it as a tool for excluding legitimate voices from the debate. Some saw greater public participation as the key to more informed, legitimate policies; others saw it as contributing to the adoption of policies that sounded good but did little to protect nature or society from the ills of industrialization. More generally, some saw science and technology as threatening the very fabric of democratic society (recall Eisenhower's famous speech about the military–industrial–academic complex). Others have seen democracy as a luxury which western societies might no longer be able to afford if they were to respond adequately to the threat of Communism and, more recently, of global ecological catastrophe.

As STS (science and technology studies) scholars began writing about science and democracy in the mid-1980s, they painted a very different picture, in which science and democracy were deeply intertwined in modern societies. Historians observed that early participants in the so-called 'scientific revolution' had imagined their work in terms that intimately connected it to the emergence of early forms of democratic citizenship (Shapin and Schaffer, 1985; Shapin, 1994; Dennis, 1989; Pocock, 1975).

At roughly the same time, other scholars were altering our understanding of the links between science and democracy in contemporary society. In a series of monographs, Sheila Jasanoff explored what she eventually termed *The Fifth Branch* of government: the scientific advisory committees that had, by the 1970s, become ubiquitous in the industrial democracies of Europe and North America (Jasanoff, 1986; 1990; Brickman *et al*, 1985; see also Wynne, 1982).

Building on much longer traditions of incorporating experts and expertise into the bureaucratic agencies of the administrative state, Americans and Europeans had turned in the postwar era to committees of independent scientists, from industry, universities, and later nongovernmental organizations, to oversee and advise the government's growing use of science and technology in the pursuit of public goals (on the longer-term development of expert agencies see, for instance, Hays (1959)). More recently, such committees have become a growing and increasingly central feature of global governing arrangements as well (Jasanoff and Wynne, 1998; Miller, 2001b; Edwards and Schneider, 2001).

Jasanoff's work opened the floodgates to a host of subsequent work that has significantly deepened our understanding of science and democracy. Some of

this has continued to expand our understanding of expert advisory committees (Yearley, 1991; Hilgartner, 2000). Other research has enhanced our understanding of quantification and classification and their important role in the administrative practices of the state and the identity politics of nationalism, especially in the social, economic, and, increasingly, information sciences (Bowker and Star, 2000; Rueschemeyer and Skocpol, 1995; Porter, 1995; Hacking, 1990; Jasanoff, 1991; Anderson, 1983).

More generally, considerable scholarship has illustrated the important role played by scientists and engineers in constructing the objects and subjects that populate modern societies (see, especially, Latour, 1987; 1988; 1993; Callon, 1986). Finally, a growing array of scholarship has explored the relationship between experts and other institutions in democratic societies, including the courts and the lay public (see, for instance, Wynne and Smith, 1989; Wynne, 1995; Jasanoff, 1996a; Epstein, 1996; Cole, 2001).

Integrating across much of this territory, Yaron Ezrahi's *The Descent of Icarus: Science and the Transformation of Contemporary Democracy* (Ezrahi, 1990) provides the historical links between the events of the 17th and 20th centuries, illustrating how science and technology have become key subjects of deliberation, contestation, and institutionalization, as western democracies have sought to integrate a commitment to freedom with an equally strong commitment to knowledge and reason in their efforts to promote a liberal political order.

One important observation that runs through much of this scholarship is that, although science and democracy have become deeply intertwined throughout the West, different societies have forged these ties along very different models. Science is a central feature of democratic imagination in the United States and Europe, yet scientists, officials, and citizens in each country imagine it somewhat differently. There is, to put it simply, no single, western model for applying science to public policy, but rather a plethora of divergent styles of incorporating scientific reasoning into political decisions.

At least until recently, for example, US expert advisory committees adopted more quantitative methodologies and were considerably more open to public scrutiny than their UK counterparts, which tended to rely more extensively on considered expert judgment formed in closed meetings.[4] The division of labor between governmental administrators and formal, nongovernmental expert associations (such as the American Medical Association) falls out along different lines in Germany and the United States, with the former relying much more heavily than the latter on nongovernmental entities for official decision-making purposes. US cancer regulators rely extensively on animal testing to determine carcinogenicity. By contrast, their UK counterparts tend to rely more strongly on epidemiological data (see, especially, Jasanoff, 1995; 1991; Brickman *et al*, 1985; Daemmrich and Krucken, 2000; Wynne, 1990; Shackley, 2001; Shackley and Wynne, 1994).

These individual examples illustrate the extent to which expertise is shaped by political culture in each country. This tie between national politics and national science, despite the strong universal and international aspects of science, both in ideology and community networks, is a crucial one for thinking about the globalization of science and democracy. The tie reflects, largely, three features of contemporary democracy. First, in each country, science is integrated into a constitutional order that itself differs from country to country, with corporatist and pluralist societies, Roman and common law traditions, and parliaments and divided executives and legislatures, to name only the most obvious differences.

More generally, the credibility of science, which is a key resource in its connections with democratic politics, often needs shoring up by broader rhetorical and institutional resources for warranting policy-relevant knowledge — resources that frequently differ strongly from culture to culture (on the social aspects of scientific credibility, see Shapin (1996)). Finally, the national state has become the largest patron of scientific research in the postwar era, attuning it increasingly to 'national needs.' From country to country, then, how people frame policy problems, the types of evidence and the styles of reasoning they bring to bear on those problems, the kinds of experts they turn to for advice, the norms of expert advisory committees, the approaches to dealing with uncertainty, and the form of regulation may all differ dramatically.

This literature raises several important questions for future research, including, especially, how the relationship between science and democracy (or governance, more generally) differs beyond the handful of North American and European cases that are well known. What do the political cultures of other important countries, such as China and India, look like? How do these, and the myriad other countries in the world, articulate in rhetorical and institutional terms the relationship between knowledge and power?

As we transit into a world in which the majority of key issues come to be framed in global terms, how do these differences in the politics of expertise map onto the new geopolitical landscape of globalization? Do

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countries respond in predictable ways that merely reinscribe long-established cultural traditions in new arenas? Or does the purportedly global character of issues such as AIDS or climate change prompt countries to reinvent themselves in new ways? Individually, how do nations and states respond to the idea that they exist in shared living arrangements with other nations and states, that they are merely a cog in a planet-sized machine?

Likewise, as the world transits into an era of global governance, many other questions raised by STS scholars about the place of the natural sciences and other forms of rational inquiry in domestic governing arrangements become increasingly relevant for global governing arrangements as well. From Jasanoff (1990; 1996b; 1998), what form do expert advisory committees take, and what roles do they play, in international institutions? From Hacking (1990), Porter (1995), and Bowker and Star (2000), how are the quantitative social sciences helping to construct notions of global society, and how have quantification and classification — what Porter calls knowledge at a distance — been enrolled in the search for objectivity in planetary public life? From Wynne (1995), what tacit models of what it means to be human are incorporated into the forms of rationality at play in international institutions?

These are not questions for the future. Already, the world is in a process of deliberate experimentation with novel forms of global governance, many of which deeply implicate science and technology. Also, we can already see the process of paradigm building at work as experimental models, which seem to some people to work well in an individual case, get scaled up to broader formats. A few examples from my own observations may help clarify just how important, far reaching, and far along these processes are.

Fifteen years ago, after dissatisfaction on many people's parts with scientific advisory processes used in negotiating landmark treaties to prevent ozone depletion, the UN established a new organization called the Intergovernmental Panel on Climate Change (IPCC). In turn, the IPCC, which is built along American notions of the organization of expert advice, has now become a model for how to build global scientific consensus on other prominent international issues, such as the recently created Millennium Ecosystem Assessment (MA) for the case of biodiversity loss.

The IPCC has also served as a model for the world's national academies to create a more general advisory committee process, the InterAcademy Council, which can be mobilized in response to any question by any country or international organization. What is as yet unclear, however, is how well the IPCC model will serve other countries, or the world as a whole, in building scientific advice that is reliable across heterogeneous social and environmental contexts and credible across divergent political cultures.

Similarly, quantification has emerged as a frequently-used tool for monitoring compliance in recent international environmental treaties, backed strongly by American officials and scientists. Statements by proponents of such measures repeat familiar themes from the work of scholars such as Ted Porter. At the same time, it is clear that numbers and quantification are not quite the technology of distance Porter claims for them.

Without an authoritative state to set standards for measurement and to help ensure compliance with measurement protocols, international society has found it difficult to generate quantitative statistics that retain their credibility much beyond the borders of the country that generated them. In addition, countries have generally proven unwilling, at the end of the 21st century, to endow new international institutions with even the same degree of power and authority to establish global statistical programs given to the UN Specialized Agencies at the end of World War II.

Consequently, in cases such as climate change, where measures of greenhouse gas emissions have come to be perceived as the gold standard for making sure that other countries are not cheating on their commitments, negotiators have had to cobble together unwieldy networks and protocols in order to generate even the semblance of methodological standardization. These 'harmonized' standards remain largely untested in the heat of either scientific or political conflict, raising questions about their long-term ability to stand as credible accounting practices for purposes of the Kyoto Protocol or other, future climate treaties.

The current accounting crisis in the United States, prompted by the reporting and auditing practices of Enron, Arthur Anderson, and numerous other companies, offers an interesting parallel. International negotiators may well find that, once the system for generating credible numbers is called into question, restoring credibility may be difficult, if not impossible, and will certainly entail a great deal of work. Indeed, analogizing the two cases raises the question of whether or not the credibility of international accounting practices will ultimately depend on the construction of state-like institutions that would duplicate the functions of an agency like the US Securities and Exchange Commission, only on global scales. Certainly the Enron–Anderson scandal raises critical questions about the stability of some of the models currently under discussion in the Kyoto Protocol process that rely solely on private auditing to bridge the gap between national and global accountability.

The relationship of science and expertise to justice and democracy in global governance thus raises a series of important questions. First, can institutions be created that can successfully manage processes of scientific and technological change on planetary scales? How will they bridge the diverse political cultures implicated in the credibility and legitimacy of national strategies for managing scientific and

technological change? What will it take, for example, to generate scientific knowledge claims that can speak with credibility on issues of risk and safety to many different public and policy audiences around the world? Whose norms and values should shape the institutionalization of global science advice?[5]

Second, and in many ways related, what would it mean to democratize science in global contexts? What norms of democratization (republican, participatory, transparent, instrumental, and so on) should govern the creation of international expert advisory institutions? Is it enough to democratize the IPCC by inviting scientists from each country, or must we democratize climate science — say, by funding climate modeling centers in India, China, and Brazil to match the current centers in the US, Japan, Canada, Germany, and the UK? Do fair global governing arrangements require, in other words, distributed scientific and technological capacity across all segments of global society? Does pluralist governance in effect demand pluralist science?[6]

Finally, can reforms in global scientific institutions contribute to, or help promote, the emergence of global democracy? If the challenge for many global policy issues is finding ways for people from all corners of the world to deliberate with one another about the future of the planet — to "reason together", as Jasanoff (1998) puts it — then can expert advisory committees be organized to facilitate that dialogue? Do other ways exist for institutional features of international scientific advisory institutions to contribute to goals such as equity, fairness, justice, and democracy in world affairs?

Conclusions

I have written this essay as a challenge to American foreign policy, although Americans are hardly alone in holding naïve views of science and technology and their relations to power and politics. I have done so because American perspectives are both centrally important to ongoing struggles to cope with the challenges of globalization and, in many cases, highly problematic. As we enter the new millennium, advances in science and technology pose enormous challenges for notions of democracy and self-determination, and the practical organization of democratic governance.

At the same time, efforts to reduce the democratic deficit in world affairs seem likely to be critical in attempting to manage ongoing processes of scientific and technological change in the 21st century. Research on science and democracy in a globalizing world thus has both a descriptive and normative imperative. How are our understandings and institutions of science and democracy changing as the world grapples with globalization? In turn, can better descriptive accounts of science, democracy, and globalization inform the development of governing arrangements to effectively manage scientific and technological change in ways that retain a strong commitment to both reason and freedom in human affairs?

I hope I have also succeeded in illustrating in the preceding sections that the relationship of science and democracy in a globalizing world raises profoundly important questions for science policy and science and technology studies. I want to close with one more brief observation about the mechanics, rather than the content, of research in this area.

Many of the conceptual and methodological tools of science and technology studies have been forged in the exploration and excavation of the local, as an explicit counterpoint to the global or universal. Seeking to demystify and deconstruct meta-narratives at work in society, STS insists that science and technology cannot be understood in terms of universal processes of truth making or a single, mechanical logic, independent of human thought, culture, and work. Instead they must be seen as human institutions, as important in their own ways as other human institutions — family, military, economy, and government — but situated in their appropriate context.

How have people in specific historical or cultural settings, we ask, gone about producing knowledge they considered scientific? How have people integrated technologies, heterogeneously, via social, political, and economic interventions, into diverse forms of life and livelihood? STS is, at heart, a community deeply concerned with thick description — ethnography, archival records, and actors' perspectives — in our search for understanding how science and technology work.

This commitment to detailed empirical work as well as theoretical sophistication has been essential to the intellectual success of the field, and I would not have it abandoned. STS acquires its credibility in large part by enabling people to see science and technology differently, through a lens that gives them richly textured views of human complexity and contingency. Yet thick description of global processes is an awesome task, especially in the humanities and social sciences with their strong traditions of intellectual individualism.

Climate scientists field modeling teams and laboratories with tens and even hundreds of collaborators working closely together. At the moment, STS has neither the financial nor human resources to pursue parallel studies of, say, the human dimensions of climate change, nor, I fear, the will or the institutional or management skills to make integrated intellectual work pay off, even if we had the money and the graduate students.

The relatively simple matter of acquiring the travel budgets to track international diplomatic and scientific processes is difficult if not impossible at present, even if we were willing to put off temporarily extensive visits to sites where global processes meet up with on-the-ground reality. STS must therefore find new ways to organize its own research to tackle problems of globalization.

Notes

1. As will become quickly apparent, my use of the word 'science' is shorthand for the broad institutions of science, engineering, technology, and medicine that constitute the production and application of knowledge in modern societies.
2. Although the discussion that follows emphasizes events after World War II, American diplomacy has given a place to science and technology since the 1860s, when the US Government began lending its scientific and engineering expertise to other countries. Programs of public health, scientific and technical education, and engineering of roads and waterworks also played important roles in American colonial policies in Cuba and Philippines. One treatment of this material can be found in Curti and Birr (1954).
3. In the language of Bruno Latour, many technologies function as 'immutable mobiles' (Latour, 1987).
4. A number of recent controversies in Britain, notably over BSE or 'mad cow' disease, have opened up particular elements of British advisory committees to public scrutiny (see, for instance, Jasanoff, 1997. The extent to which this has a permanent impact in terms of making such institutions as transparent as their American cousins is an open question.
5. A good illustration of the importance of these questions, and approaches to answering them, can be found in studies of international environmental politics. Viewed in one way, international environmental politics can be seen as an effort to protect the Earth's natural systems and processes. However, it is also clearly an effort to manage scientific and technological change on a global scale, with efforts to transform core elements of the modern industrial economy to eliminate CFC and CO_2 emissions being the most obvious examples. For reviews of this literature with a particular emphasis on the management of science and technology, see Rayner (1991); Yearley (1996); Rayner and Malone (1998); Jasanoff and Wynne (1998).
6. Here, again, it is possible to point to a contemporary example to illustrate the importance of asking such questions: studies of efforts to build a European scientific advisory system, see, especially, Liberatore (2001).

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