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The Stem Cell Debates
Lessons for Science and Politics

In December 1994, a committee that advises the director of the National Institutes of Health met on the NIH campus in Bethesda, Maryland. The meeting focused on the recent recommendation of the NIH's Human Embryo Research Panel that the federal government should fund a range of research involving human embryos.[1]

The chairman of the panel told the committee about the "extremely high level of public ignorance" about human reproduction, which "invites exploitation by those who, for moral reasons, object to human embryo research."[2] That ignorance, he warned, could be "manipulated into public hostility" toward embryo research.[3] The conversation became frankly political, as several committee members voiced concern that the incoming Republican majority in the U.S. Congress would restrict funding for the research, including expected developments with human embryonic stem cells. The committee began to brainstorm ways to shape the policy and influence public reaction so that embryo research could receive government funding with minimum opposition. One committee member proposed a sophisticated strategy of political lobbying: "have us do our homework to determine which people in Congress…have family members with which particular illnesses and make individual visits to them to 'background' them and brief them and discuss their particular family history concerns."[4] Scientists would respond to ethical objections against the destruction of nascent human life by entering the political arena; to make their case, they would rely not only on scientific facts but on emotionally charged appeals.

Fast-forward a dozen years. Embryo research became a hot-button political issue, and strikingly, just as had been anticipated in 1994, public officials and candidates for office regularly spoke about the issue in terms of their family health problems. So it was that, in considering legislation to fund embryonic stem cell research in April 2007, a series of Senators, one after another, described illnesses suffered by relatives, constituents, and themselves—a parade of maladies, from cancer to Parkinson's to diabetes to asthma. One Senator, explaining his vote in favor of using taxpayer dollars to fund embryonic stem cell research, recounted his mother's physical and mental decline due to Alzheimer's disease: "When I look at her empty gaze and shriveled body, I cannot help but wonder, if we

had started embryonic stem cell research years ago, would she still be suffering today?"[5] While these Senators understandably focused on the face of the suffering that might be relieved if human embryos were destroyed for the sake of delivering a panoply of hoped-for cures, the imperative to relieve suffering was never in dispute, and they failed entirely to attend to the nature of the human embryo and its moral status—the ethical issue that was the very center of the debate.

These two remarkable snapshots—a government scientific advisory board strategizing about political lobbying, and politicians making passionate personal pleas about science policy—give us a glimpse of the strangeness of the debates about embryonic stem cell research from the 1990s through today. The stem cell debates have shown American politics at its best and its worst, with examples both of principled democratic discourse and plainly dishonest demagoguery. And stem cell research itself has shown us science at its most noble and its most debased, with examples both of brilliant researchers pursuing cures for terrible afflictions, and others committing egregious scientific fraud in the hunt for glory. As a result, the stem cell debates have helped to reveal the knotty and complicated relationship between science and politics.

This report examines the stem cell debates in hopes of better understanding the relationship between science and politics. It lays out for the public record the most important facts and arguments, some of which have been long neglected or distorted, so that we might better understand the purpose and limits of science in a self-governing society, the proper role of scientists in American political life, and how citizens and policymakers should think about both. This report examines when, how, and why the stem cell debates sometimes lapsed into error and exaggeration. It also reflects on the value of public deliberations about the fundamental questions of bioethics.

A comprehensive history of every aspect of the stem cell debates is beyond our present purposes, although the five appendices following the body of this report, each of which can be read as a standalone chapter, offer up-to-date explanations of the science of stem cells, the medical promise of stem cells, the ethical questions raised by stem cell research, the relevant policy and legal history, and other nations' stem cell research policies.

From Discovery to Debates

Stem cells are cells that have the ability to differentiate into one or more of the types of cells of an organism's body, as well as the ability to self-renew, creating more stem cells like themselves. "Adult" stem cells—which

are found not only in adults but also in children, babies, and fetuses—are typically *multipotent*, meaning that they are capable of producing multiple (but not all) cell types.[6] Some adult stem cells have been used in medical therapies for decades. For example, bone marrow transplantation has been used to treat patients since the 1950s, years before scientists understood that it was specifically the presence of blood-forming adult stem cells in the marrow that made the treatment work.[7]

Unlike adult stem cells, embryonic stem (ES) cells are *pluripotent*, meaning that they are each theoretically capable of producing all of the cell types of the mature organism.[8] Human ES cells were first successfully derived in 1998 by cell biologist James A. Thomson of the University of Wisconsin.[9] Thomson used embryos that had been created through in vitro fertilization (IVF) but had not been used for the purpose for which they were created: being implanted in a womb so that a woman or couple undergoing fertility treatment could have a baby. There are hundreds of thousands of such unimplanted human embryos stored in freezers at IVF clinics across the United States and around the world.[10] (The science of stem cells is explained more fully in Appendix A.)

Thomson's derivation of human embryonic stem cells was a long-anticipated breakthrough. Based on studies with mice, biologists had years earlier recognized the potential value to science of human ES cells. Their potential to develop into any type of cell in the human body was expected to give researchers a powerful new tool for studying human development. But it was their hoped-for application in the new field of regenerative medicine—using ES cells to replace a patient's damaged or dying tissues—that captured the imagination of the public in the most dramatic way, as this ability could in theory allow doctors to reverse a myriad of degenerative conditions, from Parkinson's to diabetes to spinal cord injuries. Stem cells, and especially embryonic stem cells, it was believed, would help usher in a new era in medicine. (The medical promise of stem cell research is discussed in Appendix B.)

However, ES cell research has stirred persistent ethical concerns, as obtaining human ES cells typically requires destroying human embryos. Thus, ES cell research demands that we consider the moral status of the human embryo. Many proponents of ES cell research consider the human embryo to be merely a "clump of cells," morally no different from any other bit of tissue. By contrast, many critics of ES cell research argue that the human embryo is a human being at a very early stage of development, and therefore possesses at least the right not to be killed for research or to be exploited as a medical resource. Moreover, soon after human ES cells

were first derived, scientists proposed employing the same technique that had been recently used to clone Dolly the sheep to create cloned human embryos for producing patient-specific stem cells for treatments, raising public concern over the ethics of human cloning. These and other ethical dilemmas divided the public over the hope of regenerative medicine and concerns for nascent human life. (The ethical questions raised by stem cell research are explored more thoroughly in Appendix C.)

Following Thomson's discovery, stem cell research quickly became a contentious issue in American politics. The chief policy question was not whether such research should be made illegal, but whether human embryonic stem cell research should receive government funding—especially from the federal government, which is the largest source of funding for scientific and medical research in the country. On August 9, 2001, President George W. Bush announced a policy that would allow federal funding of the controversial research to proceed, but only for ES cell lines that had already been created, "where the life or death decision [had] already been made."[11] This policy would allow the government (and by extension, the American people) to support this promising area of medical research without encouraging future destruction of human embryos. The Bush funding policy became the subject of intense political conflict over the course of his presidency. It was eventually overturned by the Obama administration, which in 2009 put in place a new policy that encourages the destruction of some embryos—those produced for but not used in IVF procedures—in order to create new ES cell lines. The Obama funding policy has been challenged in a lawsuit that is currently wending its way through the federal courts. (The policy and legal history of ES cell research is laid out in Appendix D.)

Scientists, policymakers, political candidates, patient-advocacy groups, religious organizations, and other members of the public became embroiled in the debates over stem cell research. American scientists politically mobilized—as they rarely had before—in opposition to President Bush's funding policy. Stem cell research became a prominent issue in the 2004 presidential race. There were various congressional attempts to overturn President Bush's policy, and numerous initiatives at the state level, including a high-profile California referendum on funding for ES cell research. These heated debates raised important questions about the relationship between science and democracy and about how democratic politics should regulate ethically controversial research. By revisiting these debates, we address not only the particular questions regarding the ethics of embryonic stem cell research, but also questions of the place of science in the American polity.

Science, Policy, and Politics

Before focusing on the interplay of science and politics in the stem cell debates, it is useful to step back and consider how they relate in general. Broadly speaking, we can distinguish between two ways science and politics relate to one another in the United States. First, government funds, regulates, organizes, directs, endorses, and prohibits different aspects of the scientific enterprise. Second, science provides policymakers with information and advice regarding natural phenomena, technology, and other matters relevant to public policy. These different relationships between science and policy correspond to two distinct senses in which we use the term "science." When we speak of science policy as the way government supports or limits science, we are speaking of science *as a project or practice*, carried out by members of our society and subject to democratic political authority like any other activity. When we speak of the way government seeks science or scientific advice, we speak of science *as a kind of knowledge* concerning the natural world, knowledge that is subject to critical analysis and debate but not to political authority or regulation.

Although the policy questions in the stem cell debates chiefly concerned the first sort of relationship between science and politics, namely how the government ought to support or regulate this medically promising but ethically controversial field, the second sort of relationship has also been integral to the stem cell debates: scientific knowledge concerning the nature of the human embryo has been essential in informing policymakers and the public in their moral reasoning on the topic.

Historically, the federal government has provided considerable support for the scientific project. The classic articulation of postwar science policy in the United States is found in Vannevar Bush's 1945 report to President Franklin Roosevelt, *Science, The Endless Frontier*.[12] In this influential report, Bush (no relation to President Bush) argued that government funding for science, particularly for what he dubbed "basic research," was essential to ensuring that America continue to enjoy the technological progress necessary for the nation's strength and prosperity. Vannevar Bush's model of scientific progress held that basic research leads to applied research which leads to the development of useful technologies and products.[13] Following this model, the U.S. government has since the end of the Second World War provided considerable funding for scientific and medical research, with consistent public approval.

During the latter half of the twentieth century, the U.S. government also came to recognize the importance of regulating scientific research,

particularly biomedical and behavioral research conducted on human subjects. The horrific scientific experiments performed by Nazi doctors during the Second World War, along with other cruel and unethical experiments performed in the United States and around the world, clearly demonstrated the need for ethical oversight of scientific research. Governments around the world instituted policies on research ethics and the protection of human subjects, based on the principles articulated in such documents as the Nuremberg Code and the Belmont Report.[14]

Meanwhile, science, understood as our most reliable source of knowledge about the natural world, rightly enjoys a great measure of authority. In our political life, we rely on science to settle questions regarding purely physical phenomena: the toxicity of different chemicals, the efficacy of medical treatments, the sturdiness of bridges, the effects of pollution, and so on. In crafting policy, we weigh these scientific facts against other facts, interests, and values. Scientific knowledge can also inform our moral reasoning. A scientifically accurate description of biological death, for instance, is critical for determining the ethics of organ donation, and for developing sound policies to regulate organ donation.

The Bush Funding Policy: How Science Informed Ethics and Politics

Crafting morally sound policies for stem cell research requires at least three kinds of scientific knowledge: first, an account of the medical treatments that stem cell research might make possible—along with an account of the likely challenges facing this research—so that we might judge whether funding such research is in the public interest; second, an understanding of biology and specifically embryology, so that we can reason about the moral status of the human embryo; and third, an assessment of the methodology and viability of alternative sources of stem cells for research and therapy so we can consider alternative policies.

In developing his administration's stem cell funding policy, President Bush sought out scientific advice on precisely these questions.[15] These scientific matters were also central to the deliberations on stem cell research conducted by the President's Council on Bioethics that he established.[16] President Bush was aware of the potential benefits of stem cell research; he and his staff consulted a wide range of scientific and medical experts in formulating his 2001 policy, and in his speech unveiling the policy, he spoke of the "great promise" of the research to "help improve the lives of those who suffer from many terrible diseases—from juvenile

diabetes to Alzheimer's, from Parkinson's to spinal cord injuries."[17] He also alluded to scientific facts about the developing embryo: "Like a snowflake," Mr. Bush said, "each of these embryos is unique, with the unique genetic potential of an individual human being."[18]

As the science evolved in the wake of President Bush's 2001 decision, it seemed increasingly likely that new alternative techniques would make possible the creation of pluripotent stem cells without the destruction of human embryos. President Bush adjusted his administration's policy accordingly, directing the NIH in 2007 to vigorously pursue these alternatives.

Once again, scientific knowledge was crucial not only to evaluating the technical feasibility of these alternative sources for pluripotent stem cells, but also in informing the ethical judgments about the proposed alternatives. Most of the alternative sources of stem cells involve complex technical procedures, and deciding whether a particular alternative is ethically acceptable can hinge on complicated scientific questions. Recent advances in the fields of embryology, developmental biology, and epigenetics have helped scientists to better understand early human embryonic life, making it possible to distinguish between living embryos and the component parts of embryos that it would be less ethically objectionable to use for research. (The most prominent alternative stem cell techniques are discussed in detail in Appendices A and C.)

Ten Common Misrepresentations

The debates over stem cell research have dealt with a wide range of topics and issues, from cutting-edge science to deeply held moral values to arcane aspects of policy and law. In part due to the complexity of the subject, and in part due to the passionate intensity inspired by the concerns and interests on both sides, many misrepresentations, misunderstandings, and sometimes even willful deceptions became part of the debate. Public officials who may not have understood the relevant facts sometimes made misinformed and misleading claims regarding the science, while scientists sometimes misrepresented the intentions and effects of public policy. The ethical stakes in the debate were hotly contested and were subject to both accidental and knowing misinterpretation. Even academic bioethicists, who would seem to bear a professional responsibility to understand and clearly communicate the complexities of these issues to policymakers, scientists, and the general public, often twisted the facts.

We present here ten of the misrepresentations most frequently heard during the stem cell debates. In doing so, we aim to clarify the public

record and to correct some common, but important, errors that have made an already vexed controversy even more difficult. Furthermore, by better understanding the origins of these misrepresentations—when and why policymakers, scientists, bioethicists, and the public went wrong—we can better understand the relationship between science and politics.

Misrepresentation 1: The Bush administration banned stem cell research. The chief policy question concerning human ES cell research in the United States has *not* been its legality. Although there have been proposals to outlaw human cloning that would have impacted the ability of researchers to produce embryos for research purposes,[19] these measures were not passed, and there have been no serious federal proposals for a general prohibition on research destroying human embryos. Instead, the central policy question at the national level has been whether and how such research will receive taxpayer funding. The Bush policy on embryonic stem cell research—like the Dickey-Wicker Amendment, a law passed by Congress every year since 1995 to regulate embryo research (described in Appendix D)—only concerns the ability of the federal government to allocate research funding. Neither the Bush policy nor the Dickey-Wicker Amendment outlaws any kind of scientific research, nor do they pertain to the allocation of state or private funding. Indeed, in terms of the kinds of stem cell research that are legally permissible, the United States has always ranked among the most liberal countries in the world, even under the Bush policy. (Laws of other countries pertaining to human embryonic stem cell research are discussed in Appendix E.)

Nonetheless, over the past decade, the Bush policy on federal funding for embryonic stem cell research—which explicitly permits funding on cell lines derived before August 9, 2001—was frequently characterized by the media and by opponents of the policy as a "ban on stem cell research."[20] During the 2004 presidential campaign, Senator John Kerry (D.-Mass.), then running for president against Mr. Bush, said the following in a prepared radio address: "Three years ago, the President enacted a far-reaching ban on stem cell research, shutting down some of the most promising work to prevent, treat and cure Alzheimer's, Parkinson's, diabetes, AIDS and so many other life-threatening diseases."[21] Senator Kerry used the word "ban" three more times during the course of the short speech—clearly a considered and deliberate word choice intended to muddy the public understanding of the Bush funding policy, and to play into a growing political narrative that President Bush and his party were "anti-science."

To be sure, some critics of the Bush policy may have called it a "ban on stem cell research" as shorthand, as a simpler way of saying a "ban on federal funding of research on embryonic stem cell lines derived after August 9, 2001." University of Pennsylvania bioethics professor Arthur L. Caplan argued in an editorial published during the 2004 campaign season that the two ways of speaking about the Bush policy were equivalent: "prohibiting the expenditure of federal funds on embryonic stem cell research after August 2001 is a ban."[22] He has continued to repeat this claim up to the present, writing in April 2011 that the policy was "nothing more than a ban dressed up as a compromise."[23]

But describing the Bush policy as a "ban" on stem cell research obscures the important fact that stem cell research, including embryonic stem cell research, actually received federal funding under the Bush policy.[24] In fact, under the Bush policy the NIH provided $294 million for embryonic stem cell research. In fiscal year 2008 alone, the NIH distributed over $88 million in grants for more than 250 projects involving human embryonic stem cells.[25]

Moreover, describing the Bush policy's restriction on federal *funding* as a ban on *research* implies that the freedom to carry out research in the United States is tantamount to a right to receive federal funding for that research. Yet the U.S. government has always permitted many more activities than it funds, and it is not immediately clear why scientific research has more right to receive federal funding than any other socially valued activity in America. Research that involves practices that raise ethical concerns—such as the destruction of human embryos—may not enjoy a level of approbation among Americans that would justify support from the federal government.[26]

Misrepresentation 2: Embryonic stem cells are superior to adult stem cells, or adult stem cells are superior to embryonic stem cells. One of the most common misrepresentations of stem cell science and therapy has been the idea that one kind of stem cell is definitively better than other kinds. Advocates of embryonic stem cell research have often emphasized and exaggerated the potential of ES cells without acknowledging the extent to which adult stem cells may be useful to research and therapy. Meanwhile, some opponents of embryonic stem cell research have claimed that adult stem cells are definitively better than embryonic stem cells for providing therapies.

The pluripotency of ES cells makes them potentially a much more powerful medical resource than adult stem cells, which have more a limited

developmental capacity. It may be possible to use pluripotent stem cells to create nearly any kind of cells for researchers to work with in modeling diseases and testing treatments at a cellular level. And since they can make nearly any kind of cell in the body, they have long been anticipated as uniquely valuable for regenerative medicine (although the threat of transplant rejection and the risk of tumorigenicity pose significant hurdles to the successful translation of stem cell research to clinically useful medicine). Work with adult stem cells, meanwhile, faces a number of difficulties, including the problem of isolating, purifying, and cultivating them *in vitro*; and their limited potency, along with the difficulty of finding adult stem cells for every tissue type, make it particularly difficult for researchers to use adult stem cells to create tissue types for a wide variety of conditions. Researchers therefore have good reason to suppose that ES cells could be a more effective tool than adult stem cells for understanding and treating many diseases. While there are as yet no treatments in regular use that rely on human ES cells, a handful of clinical trials are now underway.

Adult stem cells, as mentioned above, have been used for years in treating patients. Some such treatments, such as the use of bone-marrow transplantation for blood diseases like leukemia, antedated the knowledge that it was specifically stem cells that made the treatment work. Even now, many of the most exciting medical advances using stem cells rely on adult stem cells, including the recent creation of an artificial trachea and the successful treatment of HIV using bone marrow transplantation.[27] Experimental studies have found evidence for the effectiveness of adult stem cells in treating a number of diseases, but it is important to remember that most stem cell-based therapies are still in the early stages of development, and it is too soon to say whether or not adult stem cells will prove effective in treating complex degenerative conditions like Parkinson's disease or spinal cord injuries. Likewise, it is too soon to say definitively whether embryonic stem cells will prove more effective than adult stem cells for treating these diseases. (For a more detailed analysis of the potential applications of adult and embryonic stem cells, see Appendices A and B.)

Critics of ES cell research generally object to it on ethical grounds, and so have an incentive to exaggerate the promise of adult stem cells, which do not raise the same ethical concerns. These critics have also unfairly downplayed the promise of ES cell research, belittling it as "wishful thinking and hype."[28]

Meanwhile, supporters of ES cell research have their own incentives to spin the science, including the desire to ensure that the research receives

government funding. As a result, they have exaggerated the promise of ES cell research. Although there has been a perception among some opponents of ES cell research that advocates deliberately denigrated the value of adult stem cells, it would be more accurate to say that advocates simply focused most of their attention on the line of research they believed to be the greater prize and did not meet less morally problematic alternatives with the same level of interest, generally because they did not see embryonic stem cell research as morally problematic in the first place.

An illustration of the distortions and exaggerations on both sides can be found in an exchange of four letters published in *Science* in 2006 and 2007. First, in July 2006, three scientists who publicly supported human ES cell research—Shane Smith, William Neaves, and Steven Teitelbaum—wrote a letter to the journal condemning the work of David A. Prentice, a biologist affiliated with a conservative think tank, who opposes human ES cell research. Smith and his colleagues argued that Prentice had exaggerated the therapeutic applications of adult stem cells in a widely publicized list of 65 diseases (and counting) that Prentice claimed were treatable by adult stem cell therapies. Most of the treatments Prentice cited, Smith and his coauthors noted, "remain unproven and await clinical validation," while others, such as those for Parkinson's and spinal cord injury, were "simply untenable." They called Prentice to task for the quality of his references, which included "various case reports, a meeting abstract, a newspaper article, and anecdotal testimony before a congressional committee," along with publications that had "nothing to do with stem cell therapy."[29]

In January 2007, *Science* published a reply from Prentice (co-written with Gene Tarne, another critic of human ES cell research) in which he defended his work on the grounds that he had not claimed adult stem cell treatments were "generally available," that they were "cures," or that they were fully approved by the FDA, merely that adult stem cell treatments have provided "observable and measurable benefit to patients." He complained that his critics had failed to acknowledge several of his more legitimate sources, and also argued that there were at the time over 1,200 clinical trials related to adult stem cells underway. However, Prentice also took the opportunity to go on the offensive, pointing out that backers of human ES cell research—including two of the authors who had criticized him in *Science*—supported groups that irresponsibly exaggerated the potential of ES cells by claiming that they could someday be used to treat or cure over 70 conditions, even though the evidence for that claim was shaky.[30]

In June 2007, the journal published another letter from Smith and his colleagues critiquing Prentice's work. This time they argued that the "enrollment of an experimental therapy in a clinical trial does not mean that it is an effective therapy." They again criticized Prentice's methods, noting that some of the 1,200-plus clinical trials he had found had nothing to do with adult stem cells. They further noted that, based on Prentice's published claims, a major conservative organization was reporting on its website that patients "have access to adult stem cell therapy which currently provides safe and successful treatments for more than 70 diseases and injuries.... These are tangible therapies that are available today."[31]

Their letter was immediately followed in the same issue of *Science* by another reply from Prentice and Tarne. They argued that their central claim that adult stem cells have provided medical benefits for patients was unaffected by the points raised by their critics regarding the amount of evidence, and reemphasized their criticism of Neaves and Teitelbaum's political involvement and the exaggerations of the value of embryonic stem cells. Each of the four letters ended with a stern rejoinder against "cruelly deceiv[ing] patients."[32]

Exaggerations and misrepresentations about the supposed superiority of embryonic or adult stem cells have waned in the last few years, partly because of the Obama administration's decision to undo the Bush policy, and partly because of the arrival on the scene of promising new sources of pluripotent stem cells that do not require the destruction of human embryos. But the exaggerations and misrepresentations have not entirely abated. While everyone hopes that stem cell therapies—whether using adult, embryonic, or some alternative source of stem cells—will deliver on their promise to provide treatments for a long list of afflictions, it is important to temper that hope with critical analysis of the scientific evidence. Experts who mischaracterize the facts risk distorting the public debate and inappropriately raising—or dashing—the hopes of patients.

Misrepresentation 3: Somatic cell nuclear transfer is not cloning and does not produce embryos. As mentioned above, the technique used to create Dolly the cloned sheep has been advocated by some scientists as a way to procure embryonic stem cells with a known genome, either to study genetic diseases or to treat particular patients. The idea of cloning human embryos in order to destroy them for the sake of creating stem cells is disturbing to many Americans in its own right, but it also raises the specter, long envisioned in works of science fiction like the 1932 novel *Brave New World*, of using the same technique to produce cloned children.

The terms "reproductive cloning" and "therapeutic cloning" came into common parlance in the 1990s to distinguish between cloning intended to create a genetically identical organism and cloning intended to produce stem cells.[33] The two terms denote the different ends to which cloning techniques might be applied, while making clear that the means in each case is cloning.

Some proponents of ES cell research responded to public concerns about cloning by engaging in terminological chicanery. They suggested that the technique used to create Dolly, somatic cell nuclear transfer (SCNT), should not be considered a kind of cloning unless it results in a viable pregnancy in the womb. This claim was most notably spelled out in a 2002 report from a National Research Council panel. The panel, chaired by Stanford University stem cell scientist Irving L. Weissman, argued that SCNT intended for reproduction and SCNT intended to create stem cell lines are "very different procedures" and that it is wrong to think of them both as kinds of cloning.[34] The product of SCNT when intended for reproduction is a cloned embryo that will be implanted in a woman's uterus, resulting in a newborn child. But, the panel argued, if SCNT is used to produce ES cells, the end product is the ES cells. Since the final step is "entirely different," the panel argued, the two procedures should be considered distinct, and should be regulated differently.[35] Weissman later explained that his panel was trying "to use neutral language…devoid of emotion-bearing terms,"[36] and so it opted to use the terms "reproductive cloning" and "nuclear transplantation to produce stem cells."[37] Many scientists, policymakers, and commentators have similarly insisted that SCNT is not cloning but is rather a technique that can be used for cloning.[38]

Relatedly, some have argued that it is inappropriate to call the artifact created by SCNT an "embryo," since that term connotes the earliest stage of a developing life, while the artifact might be destined for destruction so that its stem cells can be harvested. For example, Dr. Paul R. McHugh, a member of the President's Council on Bioethics, proposed that instead of calling the product of SCNT an embryo, we should call it a "clonote" (parallel to the word "zygote," which McHugh would restrict to the product of fertilization).[39] Other commentators have suggested still other terms for this artifact.[40]

In 2004, the leadership of the International Society for Stem Cell Research (ISSCR), an influential global organization of scientists formed in 2002, encouraged researchers to replace the term "cloning" with "nuclear transfer."[41] The ISSCR formed a "nomenclature task force" to

deal with the public-perception problems posed by the term "therapeutic cloning," and in September 2004 the organization released a position statement calling on researchers to abandon the term.[42] The following year, biotech entrepreneur Paul Abrams lectured the ISSCR annual meeting about the need to junk the term "embryonic," too: "If we adopt the view that an embryo means a cell is going to implant to make a baby, and none of what we're doing is [making] cells to implant to make a baby, and we come up with different terminology, I think we will have more long-term political success."[43]

The problem with these forays into terminological revisionism is that *the result of a successful SCNT attempt is always a cloned embryo*, a living organism at its earliest stage, genetically identical (or nearly identical) to the organism whose somatic cells were used in the procedure. While human SCNT has not yet been successfully performed to create human embryos beyond a few cell divisions, evidence from animal studies indicates that the product of SCNT would have the developmental potential of a human embryo. The entity produced by a successful SCNT procedure, if taken out of the petri dish and placed in the womb, has the potential to grow to maturity. The claim that the intention to implant or destroy this entity determines whether or not it is an embryo is confusing at best and mendacious at worst. In either case, it is certainly not based on scientific facts.

This terminological dispute arrived in a California courtroom in 2004, in a legal episode flowing from Proposition 71—a proposal that would commit the state to funding ES cell research at a large scale. Three leaders of the campaign for Proposition 71 sued to demand revisions to the state's official voter pamphlet explaining the proposed law. The pamphlet included "pro and con" statements written by advocates for and against the proposition, with the "con" statement referring to "human cloning" and noting that "the perfection of embryo cloning technology…will increase the likelihood human clones will be produced."[44] The lawsuit called those statements "false and misleading" since Proposition 71 and existing state law banned human cloning to produce children.[45] The court had to decide whether or not it was false and misleading to describe SCNT as cloning.

To support their contention that SCNT is not cloning, the plaintiffs called as expert witnesses Weissman and another stem cell scientist, Evan Y. Snyder of the Burnham Institute for Medical Research. They argued that the SCNT procedure was not the same as cloning, because researchers would never intend to implant the "product" into a woman's uterus, and therefore the process would never result in the creation of a human

child. Weissman claimed that SCNT does not produce a "human embryo clone," because the researchers destroy the blastocysts to extract ES cells, so the process "results in an embryonic stem cell line" rather than a cloned human embryo.[46]

Among the expert witnesses for the respondents was cell biologist Stuart A. Newman of New York Medical College. Newman argued that a scientist's intention to implant a cluster of liver cells in a uterus would not make them an embryo, and neither does an intention not to implant a blastocyst make it anything other than an embryo. Newman rebuked the supporters of Proposition 71 for claiming that "the material nature of a biological entity changes depending on the intention of the investigator," calling it "an example of magical thinking, which is antithetical to modern science."[47] The judge agreed, siding with the respondents and allowing the voter pamphlet to continue to mention "human embryo cloning."[48]

It is interesting to note, as Newman pointed out in his testimony, that despite the effort to police the language used to describe human cloning, "cloning" remains a widely used term of art in the field of stem cell science. In fact, one of the scientific journals dedicated to SCNT-related studies—edited by no less a luminary than Ian Wilmut, the scientist best known for creating Dolly—was called *Cloning and Stem Cells* until as recently as 2010 (when it was renamed *Cellular Reprogramming*).[49] The first apparently reliable report of human embryos created through SCNT, which was published in 2008, referred to "cloned human blastocysts" and "cloned human embryos."[50] So it is disingenuous to claim that the term cloning is simply inaccurate.

To be sure, the terms "reproductive cloning" and "therapeutic cloning" are imperfect in various ways, and several more precise terms have been proposed. For example, the President's Council on Bioethics, in its first report, *Human Cloning and Human Dignity* (2002), used the terms "cloning-to-produce-children," "cloning-for-biomedical-research," and "cloned human embryo," offering a thoughtful explanation for its choices.[51] These terms convey not just the difference of the ends of SCNT but also the similarity of the means, and they indicate that the inherent nature and status of the entity created by SCNT is the same regardless of what researchers or doctors intend to use that entity for. Any terms intended to obscure these key facts—that SCNT is a cloning technique, and that SCNT produces an embryo that must be destroyed if researchers wish to obtain ES cells from it—distort the science and mislead the policy debate. Newman's chastisement of his fellow scientists for indulging in "magical thinking" shows how advocates of ES cell research obfuscated

ethically relevant scientific facts to protect the political interests of their research project.

Misrepresentation 4: As a result of the Bush funding policy, the United States fell behind other countries in stem cell research. Commentators, advocates, and policymakers opposed to President Bush's funding policy frequently claimed over the last decade that the policy was causing the United States to fall behind other countries in stem cell research. In 2004, a group of over two hundred members of the House of Representatives signed a letter addressed to President Bush claiming that "leadership in this area of research has shifted to the United Kingdom."[52] In 2005 congressional debates, many Representatives offered variants of this claim, saying that the United States is "already falling behind the rest of the world," "falling far behind other countries, like South Korea and Singapore," "being left behind," and so on.[53] Senator Dianne Feinstein (D.-Cal.) said on the Senate floor in 2006 that Bush administration policies "have left our researchers far behind the rest of the world.... Evidence that the United States is no longer the world leader in embryonic stem cell research is mounting.... The United States... remains at the starting line."[54] Senator Barack Obama, during his 2008 presidential campaign, claimed that the Bush policy had "handcuffed our scientists and hindered our ability to compete with other nations."[55]

Were these rhetorical contentions about the effects of the Bush funding policy supported by the facts? A paper by Jason Owen-Smith and Jennifer McCormick published in *Nature Biotechnology* in 2006 purported to show that the Bush policy had resulted in a "productivity gap" between American and foreign stem cell research that posed a "danger for U.S. biomedicine."[56] This analysis was widely publicized, with major news outlets repeating the authors' judgment that U.S. stem cell researchers were "falling behind" their international counterparts.[57]

In claiming to see a "productivity gap," Owen-Smith and McCormick echoed Cold War-era talk of a "bomber gap" and "missile gap" between the United States and the Soviet Union—and just as those earlier "gaps" proved to be illusory, so too was the supposed gap in stem cell research. Notwithstanding the authors' conclusions, the data they presented told a less drastic story, showing that the United States was in fact leading the field of human embryonic stem cell research: American scientists had published nearly half of the 132 articles reviewed by the study, with the remainder of the articles divided among authors from 17 other countries. Moreover, the number of stem cell papers authored by American

scientists rose each year after the Bush policy was put in place. And 85 percent of all of the world's published ES cell research during the years the authors studied used stem cell lines approved for funding under the Bush policy.[58] The authors emphasized their finding that the proportion of studies authored by Americans declined, but that finding likely just indicated the growth of international science, in which the United States continued to provide the lead.

Two other analyses also released in 2006 confirmed that American scientists were out-publishing those from other nations. One, which counted the publications about human ES cells listed in the PubMed database between 1998 and 2005, found that 40 percent came from the United States, with the rest divided among 20 other countries. The nation with the next highest proportion was Israel, with just 13 percent.[59] The other analysis surveyed the scientific literature regarding all kinds of stem cell research (not just human ES cell research), and found that the 13,663 articles about stem cells published by American researchers between 2000 and 2004 constituted 42 percent of the world's total. German researchers were second, with just 10 percent of the total.[60] (It is worth noting that Germany's policy, which we describe in Appendix E, is more restrictive than the Bush policy.)

More recent analyses show that stem cell research flourished in the United States during the years that the Bush policy was in place, due to a combination of federal funding using the approved stem cell lines, state-funded initiatives, and private funding. In a survey of the human ES cell research literature over the past decade, *New Scientist* found that the United States has consistently dominated the field, with at least 40 percent of the world's publications in every year since 2000.[61] In the first half of 2011, 45 percent of the world's scientific publications about human ES cells had at least one American author.[62] It might be "tempting" to blame the Bush policy for making the United States fall behind in stem cell research, the magazine editorializes, but such blame would be "misplaced," both because the country *hasn't* fallen behind and because, to the extent that American researchers have proceeded slowly in bringing stem cell therapies to clinical trial, they have done so out of caution. "Again," *New Scientist* editorializes, "don't blame Bush."[63] (Of note, in the wake of President Obama's lifting of the funding restrictions, some scientists are reportedly finding that intellectual property law in the United States poses a greater obstacle to their research than did the Bush policy.[64])

The argument that the Bush policy caused the United States to fall behind other countries in embryonic stem cell research also perpetuates

a related misunderstanding, namely that the Bush policy was more onerous and restrictive than other nations' policies. In reality, many European countries have policies that are equally or more restrictive than the Bush policy. Some have banned certain forms of stem cell research and related techniques, including SCNT, while the only federal policies in the United States that explicitly touch on stem cell research have related to the qualifications for receiving government funding. Many of the nations with restrictive policies on ES cell research have produced innovative and impressive work using adult and non-embryonic pluripotent stem cells; for instance, the recent creation of an artificial trachea using adult stem cells was a collaborative effort involving researchers from several European countries, including Italy and Germany, which have some of the world's most restrictive stem cell policies.[65] (Appendix E discusses the legal and regulatory status of stem cell and embryo research in several countries and international entities.)

Meanwhile, if the Bush policy made the United States fall behind the rest of the world, then it is hard to understand why the world's first three clinical trials seeking to translate ES cell research into potential therapies have been taking place in the United States; why one of those clinical trials used ES cell lines approved for funding under the Bush policy; and why the first European clinical trial of a potential ES cell therapy, which was given the green light in 2011, is really only an extension of one of the three U.S. clinical trials, and is conducted by the same American company.[66]

Finally, it is worthwhile to state openly and to scrutinize an unspoken premise of the claim that the United States is falling behind other countries in stem cell research. To speak of "falling behind" is to suggest that the United States is in a race with other countries.[67] This suggestion is true in at least two senses: if American researchers make important discoveries in basic science, American scientific institutions will enjoy greater prestige and will attract better minds and more funding; similarly, if American researchers are the first to make marketable discoveries in applied science, American businesses will presumably profit before foreign businesses. In light of both of these hopes, the United States indeed has an interest in remaining competitive in international science. But it is surely not the *only* national interest, and to claim that the nation is falling behind in a given scientific field is not a decisive argument for rushing ahead in that field. The nation has moral responsibilities that must not be sacrificed on the altar of international competitiveness. The Bush policy sought to take those moral responsibilities seriously while allowing the science to

progress—and, as we have seen, stem cell science has indeed continued to flourish in our country.

Misrepresentation 5: More than 100 million Americans with serious illnesses could be helped with treatments derived from stem cells. A claim often repeated over the last decade by proponents of stem cell research, especially human ES cell research, is that over 100 million Americans might potentially benefit from stem-cell derived treatments. The statistic was bandied about to indicate the miraculous potential of ES cells. It appears on hundreds of thousands of websites. It was featured in the 2004 Democratic Party's national platform: "Stem cell therapy offers hope to more than 100 million Americans who have serious illnesses—from Alzheimer's to heart disease to juvenile diabetes to Parkinson's."[68] President Barack Obama cited the statistic during his 2008 campaign.[69] The 100 million figure is ubiquitous, its source is almost never mentioned, and it is rarely challenged.

Of course, we have no way of knowing how many people might be helped with stem cell-derived treatments—the science is still far too young and uncertain for any informed estimates. What, then, is the source of this statistic? How could it be that 100 million Americans—one out of every three—is ailing and in need of stem cell therapy?

The figure apparently originates in a one-page opinion piece published in *Science* in February 2000. The author, the leader of a patient advocacy group, claimed that 128 million Americans would benefit from therapies derived from pluripotent stem cells (which at the time meant only embryonic stem cells).[70] He reached this figure simply by adding up the number of Americans "affected by" cardiovascular diseases (58 million), autoimmune diseases (30 million), diabetes (16 million), osteoporosis (10 million), cancer (8.2 million), Alzheimer's disease (4 million), Parkinson's disease (1.5 million), severe burns (0.3 million), spinal cord injuries (0.25 million), and birth defects (150,000 per year).

The most charitable interpretation of the statistic is that one in three Americans might *eventually* suffer from a disease for which embryonic stem cells might *possibly* someday provide a treatment. But the statistic is usually cited in the present tense; note, for example, how the 2004 Democratic platform refers to Americans who *have* "serious illnesses." The idea that one in three Americans *currently* suffers from conditions requiring cell therapy or regenerative medicine is comically alarmist. The Centers for Disease Control and Prevention reported that in 2009, 9.4 percent of Americans described themselves as having "fair or poor

health."[71] Even if *all* of these unhealthy Americans wished to be treated with stem cell therapies, that would still only be one in ten Americans, or 30 million people. And even that scenario would depend on there being a stem cell-derived treatment for every condition affecting the health of Americans.

The methodology used to construct this figure is flawed, to put it mildly. It assumes that *all* of the patients with these ailments could be helped by stem cell-derived therapies. The notion that embryonic stem cells will provide "cures" for such broad categories of conditions as cardiovascular disease, cancer, and birth defects has only the most tenuous connection to actual stem cell science.

Misrepresentation 6: Therapies relying on stem cells are imminent. In addition to exaggerating the scope of therapeutic benefits from ES cell research, supporters of the research have exaggerated how soon such therapies would become available. There are specific examples of exaggerations from scientists, corporate spokesmen, and advocates.[72] Some of these exaggerations may have been intended to attract funding; others may have been spoken out of ignorance about the science or about the long road from basic research to clinically effective treatment. Also contributing to the overall public sense of imminent cures was the constant press coverage—headlines day after day reporting on even minor scientific papers as though they were major breakthroughs, creating the misimpression that many stem cell-based cures were only a few years away. (This kind of exaggeration has not been confined to the United States: Robert Winston, a prominent British fertility scientist, said in a 2005 speech in his capacity as president of the British Association for the Advancement of Science that "During the political campaign to encourage the U.K. Parliament to accept liberal legislation [governing ES cell research], some parliamentarians were clearly led to believe that a major clinical application was just around the corner."[73])

Policymakers also exaggerated the imminence of the research. For example, on October 11, 2004, Senator John Edwards (D.-N.C.), then a vice presidential candidate on the ticket with Senator Kerry, claimed, "If we can do the work that we can do in this country—the work we will do when John Kerry is president—people like Christopher Reeve are going to walk. Get up out of that wheelchair and walk again."[74] Reeve, who had died the day before, had been a quadriplegic since a 1995 horse-riding accident. The clear implication of Edwards's comment is that a cure for paralysis was imminent, and that a particular political result was the

necessary prerequisite of that cure. Even some supporters of ES cell research have criticized Edwards's statement as a "canonical example" of "unjustified hype."[75]

Embryonic stem cell research faces considerable hurdles before we can expect to see successful therapies from it. As we describe in Appendices A and B, stem cell therapies of all kinds are extremely complex, difficult procedures that require detailed knowledge and expertise to perform successfully. Transplanting ES cells or their products raises the problem of immune rejection, and while many have argued that therapeutic cloning could provide patient-specific stem cells, scientists have had considerable difficulty creating human embryonic stem cells using this technique, not least because of the problems associated with procuring the vast number of human eggs necessary to perform the experiments. As of this writing, ES cell therapies have only reached the earliest stages of clinical trials, and many questions related to their safety and efficacy will need to be answered before they can ever become part of regular clinical practice.

Misrepresentation 7: A clear majority of Americans supports embryonic stem cell research. A number of polls over the past decade have indicated that a majority of Americans seems to support human ES cell research—and to the extent that congressional action is a proxy for public opinion, the repeated congressional attempts to repeal the Bush funding policy suggest that ES cell research has enjoyed relatively widespread political support.[76] Critics of the Bush policy have pointed to these claims as an argument against the decision to withhold federal funds for research that most Americans wish their government to support.[77]

However, polls that found high levels of support for embryonic stem cell research were often worded in ways that obscured the ethical issues concerning the research while highlighting the potential benefits. For example, a poll of registered U.S. voters by *The Economist* during the 2004 presidential election found that 65 percent of the respondents supported embryonic stem cell research. But the question was formulated so as to tell the respondents that the reason that some people oppose stem cell research is that "it uses cells from potentially viable human embryos," while the reason some people favor the research was said to be that "the embryos otherwise would be discarded and that this research could lead to breakthroughs for treating serious diseases."[78] The respondents were not informed of the substantive ethical concern raised by the research, which is that the embryos are not just "used" but destroyed. Without this information, it is difficult for a voter who is unfamiliar with the techniques

involved in embryonic stem cell research to see what is controversial about it.

Perhaps the most careful and probing attempt to understand public opinion about stem cells was a poll conducted in 2008 by the Ethics and Public Policy Center.[79] That poll's results revealed deep public ignorance about the facts of embryonic stem cell research and confusion about the moral questions the research raises. A third of the respondents believed, incorrectly, that ES cells had "actually resulted in a cure or treatment for any diseases."[80] The poll found that 69 percent of the respondents said they supported "stem cell research"; the number dropped to 52 percent when the question asked about embryonic stem cells specifically and explained that human embryos are destroyed.[81] But when asked whether it is ethical or unethical to destroy human embryos, a majority (51 percent) said that it is unethical.[82] And 62 percent of the respondents agreed with the following statement: "An embryo is a developing human life, therefore it should not be destroyed for scientific or research purposes."[83] The poll's plainly contradictory findings show that the American public has less than a full and coherent understanding of the facts and the ethical questions of stem cell research. They also suggest a clear desire to pursue medical cures alongside a broad willingness to take into account moral challenges.

Even setting aside the empirical question of whether stem cell research is unambiguously popular, the premise of this misrepresentation is that majority opinion should act as the moral standard. Of course, in a democracy like ours, decisions are generally made according to the will of the majority. This is a fine guideline, but history is replete with examples where popular opinion proved disastrous as a moral compass. (Consider, for example, the popularity of segregation in 1950s Mississippi and Alabama.) Public figures have a duty not just to follow public opinion but also to lead it, especially on morally fraught questions—a duty, that is, to undertake the hard work of making rigorous arguments to convince minds, and expressing those arguments in a way that moves hearts.

Misrepresentation 8: Opposing embryonic stem cell research means opposing cures for suffering people. One of the tropes of the stem cell debates has been the claim that opposing ES cell research is the equivalent of opposing the potential practical, medical benefits of scientific research—as though the critics of the policy were opposed to cures. President Bush has been accused of "turn[ing] his back on the millions who stand to benefit" from ES cell research, of "putting narrow

ideology ahead of saving lives," and of telling sick people to "drop dead."[84] Opponents of ES cell research have been accused of being "against hope"—a formulation that has even made its way into political advertisements.[85] They have also routinely been called "heartless."[86] The Internet is littered with blog posts and comments from people claiming that opponents of ES cell research want people to "suffer and die."[87]

Surely not all of those who level this sort of charge against the critics of stem cell research seriously believe it; in many cases, the accusation can probably be chalked up to rhetorical excess arising in the midst of heated policy debates and political contests. Ethical argument is replaced by indignation, which in turn gives way to defamation, as these advocates of ES cell research ultimately claim that opponents do not really care for human life.

The sad irony of this line of thought is that the core *agreement* among both advocates and critics of embryonic stem cell research is that we have a fundamental obligation to protect and care for human life. The core *disagreement* is over what sorts of beings constitute human life deserving our care and protection—more specifically, over what the status of a human embryo is, and whether it deserves the protection owed to a mature human being, or no protection at all, or something in between. This question is one on which reasonable, scientifically informed people can disagree. But all of the participants in the public stem cell debates wish to see disease cured by any ethically responsible means.

Misrepresentation 9: Opposition to embryonic stem cell research is a matter of religious ideology. It is true that much of the public opposition in the United States to human embryonic stem cell research has come from religious groups, particularly the Roman Catholic Church, but also from many evangelical groups and from Americans of other faiths. This fact has sometimes been invoked by supporters of ES cell research, with two apparent implications: that the critics of ES cell research hold their views for strictly religious reasons, and that therefore their views are illegitimate.[88]

The notions that religious believers' views on stem cell research are necessarily religious opinions, and that those views should be kept out of public debates, are mistaken and undemocratic. Let us deal with these errors in reverse order.

Citizens who have made moral judgments that have a bearing on public questions have a right to attempt to persuade their fellow citizens to enact policies informed by those moral judgments. The right to partici-

pate in the political process regardless of whether our moral and political judgments are rooted in religious or secular commitments is one of the fundamental tenets of democratic self-government. While the First Amendment prohibits the government from establishing a religion, it does not deny religiously informed moral and political argument a place in the public square.

Some might argue that because religious beliefs are based on faith and revelation, they are inherently private and not open to public analysis and debate—making them subversive to sound democratic deliberation. According to this argument, even if religious views are not strictly illegitimate in public, religion is a "conversation stopper" that harms fruitful public discussion of moral or political issues.

However, in the case of the debates over human embryonic stem cell research, religious believers who oppose the research do so on grounds that are publicly intelligible, and are at least as accessible to reasoned debate as are the grounds on which supporters of embryonic stem cell research endorse the destruction of embryos. Those who oppose the destruction of human embryos argue that they are a form of human life; that human life is valuable, has certain rights, and is owed our respect; and that we therefore should not deliberately destroy human embryos for our own purposes, however noble those purposes may be. Each of these claims may be controversial, and clearly there is widespread disagreement on the moral status of the human embryo, but the argument against destroying human embryos need not depend on any theological reasoning or inaccessible faith commitments. The belief that even early human embryos are a form of human life is a straightforward interpretation of the biological facts, and while some philosophers may dispute the claim that all human life is unconditionally valuable, it is a perfectly intelligible moral position. Indeed, it is one of the great ironies of the stem cell debates that the opponents of embryo-destroying research have tended to emphasize scientific, rational knowledge concerning the nature of the embryo, while the supporters of such research have tended to rely on emotional appeals to our desire for medical treatments, or to arguments that the "personhood" we value in human life only emerges at some later, typically unspecified stage of development.

Misrepresentation 10: The Bush stem cell funding policy was an illegitimate politicization of science. This has been a prominent claim by public commentators and advocates of embryonic stem cell research—most notably President Obama, who described ending the Bush policy as a step

toward "ensuring…that we make scientific decisions based on facts, not ideology."[89]

In point of fact, there are no participants in the stem cell debates who will deny, if pressed, that public policy must be based on both facts and moral considerations. For instance, in the very same remarks, President Obama noted that he would restrict federal funding for reproductive cloning because it is "profoundly wrong, and has no place in our society, or any society"—moral judgments that are not settled by scientific fact alone. Other aspects of science policy are obviously moral as well: for example, there is universal agreement today that scientific research on human subjects ought to be conducted with informed consent, a principle that arose in part out of the horror at the work of the Nazi doctors and the Tuskegee experiments. Yet, although informed consent is by definition a restriction on scientific autonomy, no credible person would dismiss it as an improper "ideological" imposition. The notion of a purely scientific decision is itself meaningless: it would be impossible, even if we wished to, to decide what we ought or ought not to do based on scientific facts alone, without relying upon principles of some sort. Even the value we place on scientific inquiry and knowledge is itself non-scientific—that is, we value science because we value knowledge and the practical goods that science can bring us; but scientific knowledge is itself neutral as to whether or not we should value it, or for that matter whether we should value the scientific project that provides us with this knowledge. Pretending that we can somehow denude science policy of moral judgment confuses the public understanding about the proper relationship between science, moral judgment, and public policy. It also threatens to erode the foundation for restricting even those forms of research that most people agree violate ethical principles.

As we reflect on the stem cell debates, there are three key points on which all participants should and generally do agree: (1) the advancement of scientific knowledge, as part of our broader search for knowledge and truth, is good for its own sake; (2) scientific research is of enormous value for the medical and practical benefits it has brought and may yet bring; and (3) society in general, and public funding in particular, ought to support scientific research to the greatest extent that is ethically (and fiscally) responsible. The central question in the debates has been, again, whether experimentation on embryonic stem cells obtained by destroying human embryos is ethical—a matter upon which reasonable, scientifically informed people can be expected to disagree. The claim that it is illegitimate for these ethical views to be expressed in public policy represents a

profound misunderstanding of the proper relationship between science and politics. We say more about that relationship in this report's conclusion.

Case Studies from the Stem Cell Debates

The stem cell debates were carried out in scientific journals, bioethics magazines, and the popular press, in classrooms, conference halls, and political campaigns. In this section, we examine a handful of critical incidents and individuals from the stem cell debates, the better to understand the complicated relationship between science, ethics, and political practice.

Scientific Expertise and Policy—Counting the Stem Cell Lines. A key element of President Bush's 2001 funding policy was the existence of established stem cell lines, the use of which Bush believed could be ethically justified on the grounds that the direct act of destroying the embryos had not been incentivized or rewarded by the government. But a considerable controversy developed over the number of stem cell lines that were available, with one critic describing the number of cell lines estimated by the administration as "one of the most flagrant purely scientific deceptions ever perpetrated by a U.S. president on an unsuspecting public."[90] Examining this controversy points to important questions not only about the particular facts at dispute in this controversy, but about how policymakers should act in light of evolving factual knowledge.

Research involving mouse ES cells, which were first derived in 1981,[91] had almost entirely relied on just two lines of ES cells.[92] Proponents of human ES cell research believed that only a handful of stem cell lines would be necessary for the work to progress significantly, with Stanford researcher Irving Weissman telling the *New York Times* that "a finite number [of ES cell lines] would be sufficient.... If we had ten to fifteen cell lines, no one would complain."[93]

At President Bush's request, the National Institutes of Health in 2001 conducted a global survey of stem cell researchers; the agency reported back to the White House that roughly sixty stem cell lines had been established.[94] That was the figure Bush cited in his address on August 9, 2001: "As a result of private research, more than sixty genetically diverse stem cell lines already exist.... Leading scientists tell me research on these sixty lines has great promise that could lead to breakthrough therapies and cures."[95]

However, many of the ES cell lines that had been created were either not viable or not available under intellectual property restrictions. The

number of ES cell lines eligible for federal funding under the Bush policy dipped down to eleven and then rose to a final number of twenty-one.[96]

Although the number of ES cell lines eligible for funding under the Bush policy was in keeping with what researchers like Dr. Weissman had hoped for, they grew dissatisfied. With respect to the eleven cell lines available in 2003, Weissman said, "you are only looking at the genetics of people who go to in vitro fertility clinics—the white, the rich, and the infertile."[97]

(Weissman's comment, of course, reveals dissatisfaction with more than just the *number* of stem cell lines available; his criticism of the *kind* of embryos from which the cells were derived is tied to his longtime support of cloning for biomedical research, since cloning would make it possible to create stem cells that would be genetically identical to patients, allowing researchers to study genetic diseases at a cellular level. In 2002, Dr. Weissman launched a program at Stanford, among the stated aims of which is to clone human embryos for research purposes, and he continues to insist that the government should fund research on stem cell lines derived from cloned embryos.[98])

Although President Bush's estimate of the number of established ES cell lines was based on the NIH survey, his political critics accused him of intentionally lying about the number—as part of a growing narrative that the president and his party were "anti-science." Bush's claim that there were sixty ES cell lines was "a morsel of scientific misinformation so stunning…that one can only wonder what Bush and his handlers were thinking, or whether they were thinking at all," wrote journalist Chris Mooney in his 2005 book *The Republican War on Science*.[99]

Revisiting the scientists' complaints about the number of lines approved under the Bush policy with the perspective of a few more years, it turns out that American researchers have overwhelmingly relied on just two of the twenty-one approved ES cell lines. Studies on a diversity of cell lines do have certain scientific advantages, but most researchers have preferred to work with the well-characterized H1 and H9 cell lines, which have a proven track record of productivity.[100] Even after the new Obama funding policy went into effect, the Bush-approved lines remained by far the most widely used: a survey of the research presented at the 2010 International Society for Stem Cell Research conference found that over three-quarters of studies employed one or more of the cell lines approved under the Bush policy, and only 8 percent of studies used one of the cell lines newly approved under the Obama policy but not under the Bush policy.[101] And while it is still too early to know what effects the Obama funding policy will have, a 2009 article in *Nature Biotechnology* pointed out that the Bush

funding policy may have had the beneficial consequence of establishing "a reproducible yet small number of well-characterized lines [that] are now used as references for the community of stem cell researchers."[102]

One way to understand the controversy over the number of available stem cell lines is as a consequence of the differing aims of democratic government and technical expertise. Policymakers have a responsibility to seek out the best available expertise to inform their decisions. But experts disagree with one another, and their advice can rapidly shift with evolving knowledge. To accuse President Bush of "flagrant deception" for saying that sixty stem cell lines existed is to assume he acted in bad faith, when in truth our knowledge of the facts changed—just as the evolving factual landscape led scientists like Dr. Weissman to revise their views about the number of ES cell lines "sufficient" to advance the field. Moreover, and perhaps more importantly, these accusations of dishonesty ignore the broader issue that the Bush stem cell policy was primarily shaped not as a technical response to specific claims about a number of available stem cell lines, but as a considered effort to advance stem cell science within responsible ethical constraints.

Politics Distorting the Science—Ron Reagan and the Future of Medicine. During the 2004 political season, stem cell research became a major issue. Scientists organized and mobilized politically to a degree not seen since the 1964 presidential election;[103] candidates for office gave speeches and purchased advertisements criticizing their opponents' views on stem cell research; and the research became the focus of a major ballot initiative in California. We have already mentioned several misrepresentations that arose during the 2004 presidential campaign, including the repeated characterization of the Bush funding policy as a "ban" and Senator Edwards's remarks about an imminent cure for paralysis.

The episode that epitomized the grossly misleading tactics employed in the stem cell debates occurred at the Democratic National Convention in July 2004. One convention speaker after another invoked the promise of stem cells and decried the supposed ban on research; the phrase "stem cell" was uttered twenty times, making it one of the policy topics most mentioned from the podium.[104] Then, on July 27, just fifteen minutes after the keynote address by then-state senator Barack Obama, Ron Reagan, the son of the late President Ronald Reagan, rose to give a primetime speech advocating human embryonic stem cell research.

Reagan began by disavowing that he was delivering a political speech—although he was at a party convention, surrounded by throngs of cheering

partisans, speaking on a subject that the Democratic Party had sought to use as a "wedge issue."[105] His talk certainly had all the trappings of a political speech, including policy recommendations and a stirring peroration promising voters that the Democratic ticket would ensure progress.

Given the attention Reagan's speech enjoyed, with ample news coverage and a live television audience of millions,[106] it is worth looking closely at the way his remarks irresponsibly distorted the scientific facts—both in what he said and what he did not.

First, Mr. Reagan wildly exaggerated both the promise and the imminence of treatments derived from ES cells. Although the science was still very young and unsettled, he claimed that ES cell-derived treatments for Parkinson's disease would be available "ten or so years from now," and described ES cell therapy as "what may be the greatest medical breakthrough in our or any lifetime"—apparently greater even than vaccination and antibiotics, which have saved hundreds of millions of lives.[107]

Second, Reagan never explicitly stated that human ES cells are derived from human embryos that are destroyed in the process. Only attentive listeners already familiar with the science would have recognized that when Reagan spoke of "these cells" and "these undifferentiated cells multiplying in a tissue culture" he was referring not to the ES cells but to embryos themselves. In this way, Reagan avoided acknowledging that the embryo is a human organism—only conceding that "these cells could theoretically have the potential, under very different circumstances" to develop into recognizably human beings. Nor did he ever explain that creating ES cells requires the destruction of human embryos; he referred only to "interfering with the development" of embryos.

Third, he also eschewed the word "cloning," even though he gave a two-sentence description of the SCNT therapeutic cloning procedure. The artifact resulting from that procedure is a cloned human embryo, a genetic near-duplicate of another human being. (Reagan also alluded to the cloning process by saying that ES cells are "created using the material of our own bodies"—a misleading turn of phrase that suggests that ES cells are, like adult stem cells, *only* made from our bodies and do not entail the destruction of distinct organisms.)

Finally, Reagan was silent on what it would take for his vision of ES cell-based regenerative medicine—"your own personal biological repair kit standing by at the hospital"—to become a reality. For even just 1 percent of the American population to have such "repair kits" awaiting them in hospitals, the nation would first have to launch a massive project to harvest millions of eggs from women, a painful and sometimes quite dangerous

procedure. Given the necessary scale, it would surely be impossible to rely only on donated eggs, as Mr. Reagan claimed. Furthermore, we would also have to establish a vast cloning program to create the embryos from which the personalized ES cells could be collected. No wonder Reagan left these facts unsaid: to even contemplate these practical requirements of his vision would surely make the average voter blanch.

Ron Reagan's rhetoric, and the moral and political logic of his speech, reveal the way that scientific progressivism is rooted in charity—in this case, the compassionate desire to ease suffering and find cures. But if unrestrained by other moral and political goods, the impulse for scientific progress can ultimately pervert both science and compassion: and so we witness an advocate for scientific research misleading millions about science, and calling for cures that require egg-harvesting and cloning programs of dystopian dimensions.[108]

Selling Cells—California's Proposition 71. At the same time that stem cell research returned to the national spotlight during the 2004 presidential campaign, it also became a heated issue in California state politics. Proposition 71, a ballot measure called the California Stem Cell Research and Cures Initiative, proposed making stem cell research a constitutional right in the state and establishing an institute for regenerative medicine to fund it. The institute would make $3 billion in grants available to stem cell researchers over ten years, including grants for the creation of new ES cell lines through SCNT—so state taxpayers would underwrite both the creation of human embryos through cloning, and the destruction of those embryos for parts.[109] (For comparison, the NIH now spends roughly $1 billion annually on all forms of stem cell research, with human ES cell research receiving about a tenth of that figure, and none of it directly funding the cloning or destruction of embryos.[110]) The $3 billion would come from general obligation bonds, which would be paid back over thirty years at an estimated total cost to state taxpayers of $6 billion.[111]

Supporters of Proposition 71 framed the vote as a referendum on the stature of science and the need for cures. Funding for stem cell research, they contended, was the scientifically sound policy choice, while opposition to the research resulted from religious ideology or confusion about the scientific facts. Their campaign was well organized and amply funded; it raised and spent $21.6 million to convince California voters, roughly a hundred times more than the campaign against the proposition. The yes-on-71 campaign also had an unambiguous message for voters: funding stem cell research would bring cures to millions of sick Californians.

Written into the language of the proposition was the claim that "about half of California's families have a child or adult who has suffered or will suffer" from a condition that stem cell research will or could potentially treat or cure.[112] Television and radio advertisements, and the campaign's website (CuresForCalifornia.com), made emotional appeals about the urgent need for the cures that stem cells could provide millions of Californians.[113]

Meanwhile, the opponents of Proposition 71 distanced themselves from the question of the moral status of the embryo so as to better court voters in a state that overwhelmingly supports legalized abortion. In fact, they recruited to their cause groups and individuals who supported abortion, and even supported ES cell research, but who opposed the proposition because it supported cloning. (As one prominent feminist critic of Proposition 71 put it, cloning involves "substantial short-term risks to women who would undergo multiple egg extraction" to provide the necessary eggs.[114]) The opponents of Proposition 71 also sought to focus public attention on the myriad other political, economic, and ethical issues raised by the proposal.

On Election Day, the proposition passed by a wide margin (59 percent to 41 percent).[115]

No one should be surprised that the campaign for Proposition 71 relied on exaggerated emotional appeals, such as advertisements featuring a patient with Parkinson's disease saying that "we all are exposed and potentially patients of these diseases," and actor Christopher Reeve saying that by voting yes on Proposition 71, "you could save the life of someone you love."[116] After all, political campaigns aim at persuading citizens, not providing objective scientific analysis. But it is remarkable the extent to which those appeals overwhelmed other concerns, including concerns that usually resonate with voters: the cost to taxpayers, the stewardship of the state's already strained budget, and the lack of fiscal accountability and transparency.[117] That these pocketbook issues were so resoundingly defeated at the polls speaks to the powerful yearning for cures and health.

Ethical Limits and the Stature of Science—The Case of Paul Berg. Stanford University biochemist Paul Berg, a Nobel laureate, was the architect of the famous 1975 Asilomar Conference, at which scientists adopted voluntary guidelines to avoid potentially hazardous outcomes from research involving recombinant DNA technology. During that episode in the history of genetic research, both scientists and regulators acted with restraint: scientists, including Berg himself, refrained from performing new experiments, instead imposing a voluntary moratorium,

while regulators and other public officials gave scientists time to assess the dangers involved in the new genetic engineering techniques. Berg became known as a model of a scientist who understands the need for science to be governed and restrained by ethical boundaries—and so it is worth examining his role in the stem cell debates.

Berg was a prominent opponent of the Bush stem cell policy. In discussing the moral controversy underlying the stem cell debates, he acknowledged the "deeply held religious views" of some that "destruction of the blastocyst is murder."[118] But he ignored the fact that many considered such destruction not to be murder but still to be morally problematic, and he ignored the fact that many people held these views without religious motivation, and even without themselves being religious. He has also dismissed religious views "that [say], 'we dare not sacrifice a life for any purpose.'"[119] Of course, this view is not specifically religious; it is, in fact, widely held. We would never consider it justifiable to sacrifice and vivisect an infant or adult human being, whatever promising medical research might result. His condescending depiction of "confused and even fearful" citizens who "reject the tenets of evolution in favor of the Bible's literal version of creation," and of "social conservatives" who are "actively demonizing scientists conducting research on AIDS and reproductive technologies" smears the serious critics of ES cell research. He crudely conflates opposition to the practice of killing embryos with an opposition to or ignorance of scientific knowledge as such.

Berg's rhetoric broadly illustrates the problematic way that many scientists viewed the relationship between science and politics in the stem cell debates. Berg loosely articulates "the 'social contract' between the public and science," which he describes by speaking longingly of the post-World War II era in which "the federal government enthusiastically embraced untargeted research, what some often refer to as curiosity-driven research," and "the public did not question the value of this research." In apparent contrast to this, Berg says that "what is so troubling about this [stem cell] dispute is that social conservatives and their political representatives are poised to define the boundaries and even the limits of scientific research."[120]

It should instead be troubling that a prominent and decorated scientist, one respected for having helped place ethically-guided restrictions on scientific research, would find it troubling that political representatives might wish to do the same. In a 2002 interview, Berg criticized a proposed cloning ban this way: "If you think about the arrogance of it, you'd say, my God, these 500 guys sitting in Washington—a majority of them—have

said, 'We're not comfortable with this way of doing things. It offends my sensibility,' or whatever."[121] Not only does this statement evince an unwillingness to take seriously the arguments against cloning, it also expresses a clear disdain for representative government and the role that legislation and regulation play in establishing ethical guidelines for scientific research.

Describing embryonic stem cell research, Berg has mourned that the "quality of the science and its potential benefits may no longer be the principal determinant of whether a particular line of research should be permitted."[122] This is a strange sentiment. With respect to whether particular research should be *permitted*, its quality and benefits are not considerations in the first place: certainly the government has no business passing laws prohibiting research simply because it is useless or poorly conducted. However, when it comes to *allocating public funds* for research, government agencies continue to make quality and utility primary determinants for distributing grants, while not funding research that violates ethical guidelines. The dispute, as always, remains what those ethical guidelines ought to be.

Berg worries about the stature of science in American society: "After decades of being heroes, heralded as the driving forces behind the country's progress, the role of scientists in our society is up for grabs."[123] This is an overstatement. Americans continue to regard the men and women of the scientific community with esteem and gratitude for their commitment to uncovering the secrets of nature for the benefit of mankind—and continue to supply public funds that evince that regard. But while we respect the ways that scientists have made us masters and possessors of nature, we must not forget that the responsibility for deciding on ethical limits to (and public financing of) scientific activities in a democracy rests with the public at large, of which scientists (and academic bioethicists) are but a small part. The need for public deliberation on ethically controversial research is an essential part of our nation's social contract with science, not an assault on the legitimate authority of the scientific enterprise.

Lessons of the Stem Cell Debates

Science has an important place in American society, and future scientific advances—especially in biomedicine—promise to profoundly shape American life. While the stem cell debates heightened some political tensions considerably and introduced into the public square a great deal of misrepresentation and confusion, they were also an opportunity to better

understand the relationship between science, ethics, and democratic politics. The lessons we can draw from the stem cell debates may help us address controversies that arise from scientific developments in the future.

Science Informs Ethics. First, the stem cell debates remind us that scientific knowledge contributes to sound ethical analysis. The tantalizing possibility of cures for a wide range of diseases—and the ethical imperative to undertake research in pursuit of these cures—grew out of our scientific knowledge of the pluripotent property of embryonic stem cells, and their promise as a source of cellular and regenerative therapies. Equally important, however, was the contribution of the science of embryology for informing our reasoning about the moral status of the embryo itself. The biological significance of fertilization as the beginning of a human life underlies the moral meaning of human embryonic life for most opponents of ES cell research.

Knowledge of embryology, developmental biology, and cellular biology also contributed to our understanding of the less ethically problematic alternative sources of stem cells. Many proposed alternative sources depended on answers to questions regarding the biological status of particular embryos or embryo-like entities: extracting stem cells from "organismically dead embryos," for example, requires a scientifically accurate definition of embryonic death and a scientifically sound method for determining when an embryo satisfies that definition. Likewise, the Altered Nuclear Transfer proposal depends on having an accurate scientific understanding of the essential features of an embryo, along with a reliable technique for creating entities that lack these features.

Ethics Guides Science. While the ethical positions of both proponents and opponents of ES cell research were informed by scientific knowledge, in neither case was ethical reasoning simply reducible to, or resolvable by means of, scientific facts. While the science shows that the embryo is the beginning of a human life, opposing the destruction of human embryonic life depends on the ethical judgment that all human life is valuable, regardless of size, abilities, or age. Likewise, while there were good scientific reasons for supposing that ES cell research could allow for medical therapies in the future, the value that we place on relieving suffering and treating disease played an important role in assessing the ethical value of the research that held the hope of achieving these ends. Indeed, given the scientific uncertainty regarding the actual promise of the field, the value we place on pursuing medical research to relieve suffering may have

played a comparatively large role in inspiring the hope of many embryonic stem cell advocates. And so we find that ethical values shape the priorities of and set limits on the scientific enterprise.

Modern science has had charitable aims since its beginnings, when Francis Bacon argued that the "end of knowledge" is "the glory of the Creator and the relief of man's estate."[124] The pursuit of new biomedical technology—including stem cell research—is one of the most impressive manifestations of this beneficent impulse. But notwithstanding the charitable aims of modern science, ethical reflection is still needed to evaluate how particular scientific advances will contribute to or diminish human flourishing. While many of the forms of therapy promised by stem cell research would be morally laudable efforts to relieve suffering and treat disease, some potential applications of stem cells to reproductive technology or the modification or enhancement of human beings raise their own ethical questions.

In addition, ethics must place limits on what scientists do while carrying out their research. For example, they must not perform cruel or degrading experiments on human beings, regardless of the potential scientific or practical value of such experiments. Even though the scientific project is animated by broadly charitable intentions, scientists and advocates for scientific research still must reflect on the ethical implications of their experiments before carrying them out. As human beings with consciences and powers of moral reasoning, scientists are naturally equipped to consider whether the conduct of their research is cruel, inhumane, or unethical, and they are likewise capable of restraining their activities in the light of such ethical reflection. Of course, this ability does not mean that scientists are the sole moral arbiters of their own work, nor that their opinion on this point is the final word. Given the public place of science and the public consequences of unethical scientific activities, we all have a role in our democracy in deliberating about the ethics of scientific conduct and the aims that science ought to pursue.

We all share in the hope that modern biomedical research will relieve the suffering of people with serious illnesses or injuries, but we must not forget that science needs ethical boundaries, even in pursuit of a compelling cause. For there is an inherent danger in our quest for cures: it always contains a sense of immediate imperative born of desperation. This is a wholly understandable disposition, but it means that the argument from suffering must always be tempered by a more dispassionate perspective on the promise of science and the broader range of human priorities. Absent this balance, the curative quest on its own knows no bottom, and no end

to what it might justify if we make it our highest goal. The dangers of this imbalanced impulse were in evidence in many of the arguments in favor of unrestricted embryonic stem cell research that appealed to the persuasive power of sentiment, while ignoring or distorting broader ethical, practical, and scientific concerns. Ethical reflection about and boundaries on science are thus especially necessary when research is conducted in pursuit of compelling causes like the relief of suffering and the treatment of serious illness.

Science Informs Politics. To make informed decisions about both the potential and ethical implications of stem cell research, policymakers required accurate, objective scientific advice. As with any case where scientists are seeking government funding, policymakers needed to assess how valuable the research would be for the public interest. That is, they needed accurate, objective scientific advice about the potential of stem cell science to contribute to promising biomedical advances in order to fairly assess what place this research should have among our many public priorities. Exaggerated claims—such as the notion that ES cell research will provide cures for over 100 million Americans—distort the science so as to make the research seem far more valuable than a more sober assessment of its potential would suggest. Stem cell science is still at an early stage, and while it is clearly a promising field, the extent of its ability to deliver on this promise remains uncertain. Furthermore, it is one promising field among many that are calling for public resources. Nevertheless, while accurately assessing the potential of an emerging scientific field is always difficult, policymakers facing the stem cell issue in 2001 needed to make decisions based on the limited knowledge available when the science was still in its earliest stages. In the years since, just as scientific knowledge informed our reasoning on the moral status of the embryo, it also helped policymakers and the public judge how to fund and govern the research.

Politics Governs Science. Scientific research requires many things from the government, including money, support, and regulation. Scientists carrying out research on embryonic stem cells sought funding from the federal government, implicitly arguing that the potential of their work to provide medical therapies made it worthy of public support. Policymakers were called upon to make a difficult decision regarding the funding of research that promised great medical benefits but also raised troubling ethical concerns. This conflict over values made the stem cell question one that required a political resolution; it was not a technical problem that

could be settled by scientific expertise. Because the political controversy over the research was rooted in ethical concerns over the moral status of the embryo, policymakers could not make their decision by deferring to scientific expertise, as scientific expertise could only *inform* the moral question, not *resolve* it. A policy that provided unconditional support to embryonic stem cell research would favor scientific research and ignore or reject ethical concerns regarding the destruction of the embryo, but such a policy would not be based simply on scientific facts any more than a policy that restricted support for the research in light of ethical concerns.

When President Obama overturned the Bush stem cell research policy in 2009, he framed his decision as "an important step in advancing the cause of science in America."[125] Insofar as the new policy expanded the range of scientific activities that would be supported by the government to include practices that many Americans find unethical, the policy does advance the cause of scientific research in America, although at a cost to the ethical treatment of early human life.

Strangely, however, President Obama went on to say that "Promoting science isn't just about providing resources; it's also about protecting free and open inquiry. It's about letting scientists…do their jobs, free from manipulation or coercion and listening to what they tell us, even when it's inconvenient. Especially when it's inconvenient."[126] The president seems in these remarks to be comparing the stem cell debates to other debates about the relationship between science and politics; the word "inconvenient" is likely an allusion to Al Gore's climate-change movie *An Inconvenient Truth*. But as a description of the stem cell debates, the president's remarks are woefully inapt. The policy debate over ES cell research was *precisely* over the extent to which the government ought to provide resources for that research. But there was no attack on the "free and open inquiry" of stem cell scientists, nor were ES cell researchers subjected to "manipulation or coercion" under the Bush policy, as Obama implied. The idea that we must listen to scientists "even when it's inconvenient" seems particularly bizarre in light of the actual policy debates that occurred concerning embryonic stem cell research. Opponents did not find any of the claims made by scientists "inconvenient," and there is certainly nothing "convenient" about opposing this research. Opponents of ES cell research generally acknowledge that the research has promise; they simply believe that the ethical concerns attendant upon the research, especially involving the destruction of human embryos, should cause us to seek alternatives. Indeed, one might say that the "inconvenient truth" in the stem cell debates—a truth that we cannot and should not hide, either

through terminological sleights of hand or by simply ignoring it—is that the pursuit of much-wanted cures requires the destruction of nascent human lives.

It seems clear that President Obama was attempting to argue that, in the stem cell debate and elsewhere, science ought to be placed above politics. This hierarchy seems to be in keeping with the promise in his inaugural address to "restore science to its rightful place."[127] Such rhetoric trades on an ambiguity we previously noted in the meaning of the term "science." The language Obama used to justify his stem cell policy and obliquely criticize the Bush policy refers more to science as a form of *knowledge* than science as a *practice* carried out by scientists. While government has authority to regulate the activities and practices of science, insofar as those activities can be unethical or dangerous or otherwise contrary to the public interest, the government rarely has business regulating scientific knowledge. Likewise, while the government need not automatically grant funding to scientists who request support for their research, particularly when that research involves practices held to be unethical, policymakers ought to listen to what scientists tell them and recognize the authority scientific knowledge has in our society. The controversy over the Bush policy resulted not from a failure of policymakers to listen to the scientific facts presented to them, but rather from the policy decision not to grant unrestrained federal funding for ethically problematic research.

Debates over ethically contentious scientific research are necessarily political in nature. The fact that society can be sharply divided on the ethical acceptability of a form of scientific research means that there will arise conflicts requiring political resolution. If we simply ignored the ethical concerns of millions of Americans and provided funding for research involving the destruction of human embryos, we would not be putting science in its "rightful place" above politics and ideology. Rather, we would simply be making a political decision to disregard particular ethical concerns.

Instead of asking about the proper place of science, we might ask about the proper place of politics in a society dominated by science. We are profoundly grateful for the many blessings of science, but we believe that the practice of science is and must remain governed by politics, properly understood as the practice by which we regulate the terms on which we live our lives in common. That does not mean that politicians should distort scientific findings; rather, it means that scientific findings should inform policy judgments that also take into account many other crucial

factors. Science does not inherently respect human dignity; it does not of itself show us how best to govern our societies or our selves. Our children should be educated in science, but also raised to respect virtues for which science has no inherent regard. Scientific research should be publicly funded, but only in balance with other goods and never in violation of our fundamental political values. And policy decisions should be informed by science, but only alongside the political, social, and economic concerns that, in our democracy, reflect our efforts to live well and wisely.

The Integrity of Science. In the stem cell debates, scientists desired funding from the government, and public officials needed solid scientific findings to inform their decisions about how best to support and regulate research in the public interest and in accordance with ethical principles. This situation led to something of a conflict of interest for the scientific community: on the one hand, scientists sought support for a promising but controversial area of research; on the other hand, they had a responsibility to provide objective advice to policymakers facing difficult decisions. Furthermore, the debate over embryonic stem cell research was highly complex, involving many interrelated technical, scientific, ethical, and political problems. This daunting complexity made many policymakers and the public at large particularly reliant on expert advice for shaping their thinking on the issue.

Proponents of ES cell research argued that they were defending the integrity of science against unwarranted interference. But as we have shown in this report, the most egregious distortions of scientific knowledge were perpetuated by the advocates, not the critics, of ES cell research. Critics sought to place ethical limits on the conduct of scientific research—ethical limits that were based on a scientifically informed and accurate understanding of the moral meaning of human embryonic life. Advocates of stem cell research sought public support for an ethically problematic area of the scientific enterprise, which led many of them to distort the scientific findings and prospects of the research to strengthen their political case.

The integrity of science was also threatened by the attempt to extend the authority of science beyond purely scientific questions to political debates involving ethical questions of the meaning and significance of human equality—questions that are deeply contested in American society, and that science alone cannot resolve. During the stem cell debates, the interests of science-as-a-practice were sometimes treated with the same elevated respect that we rightly accord to science-as-a-kind-of-knowledge—a respect owed in large measure because the knowledge

science brings is always open to further scrutiny, rational discussion, and, as necessary, revision. Conflating these two distinct senses of science clouded democratic decision-making and risked ultimately diminishing the respect we properly have for scientific knowledge.

Science gives us an incredibly powerful way of knowing the natural world, and offers power over nature that provides us with ever-improving standards of material wellbeing and health. For this, we are all profoundly grateful. But in our gratitude we must not forget that there is more to life than material wellbeing, health, and power, and in our respect for the amazing advances in knowledge that modern science has made, we must not forget that there are moral questions that science alone is unable to answer.

Beyond the Stem Cell Debates

The controversy over embryonic stem cell research has revolved largely around the question of the moral status of the human embryo. However, with the advent of alternatives to ES cell research, including techniques for reprogramming cells and creating embryo-like entities, there is reason to hope that the lifesaving promise of regenerative medicine and cell therapy can be pursued without destroying human embryos. The potential circumvention of the embryonic stem cell controversy by scientific advances shows how conflicts between ethics and science need not always be irreconcilable.

The controversy over ES cell research may ultimately be sidestepped through the development of novel scientific techniques. Or alternatively, it may not—and the tension between our respect for nascent human life and our desire for medically and scientifically promising research may persist, and with it will persist passionately contested democratic debates. Moreover, the very technologies that may allow us to get beyond the ethical issues related to the destruction of human embryos may themselves create new ethical dilemmas. The techniques that provide ethical alternatives to ES cells also provide increasing power over human biology at the reproductive, developmental, and cellular levels. While the use of these techniques to circumvent the destruction of human embryos is praiseworthy, the power to transform and reprogram human cells may contribute to our ability to genetically engineer human beings, or possibly transform adult human tissues into developing human embryos. Moreover, many other potential uses in a wide range of research applications for cells and tissues from developing human life may well become evident. Strange

new possibilities in human reproduction will present themselves, as will new techniques that could blur the boundaries between human and animal life. As science continues to advance, giving us new technological powers over human biology, we will need to remain watchful of both the means by which scientists conduct their research and the ends for which that research is conducted.

The potential resolution of the dilemmas of embryo-destroying research also affords us an opportunity to reconsider moral questions our society has barely begun to confront: those raised by the assisted reproductive technologies that made embryonic stem cell research possible in the first place. Fertility clinics, which help tens of thousands of Americans to have children every year, have also created hundreds of thousands of human embryos that are kept in freezers, donated to other parents, or simply discarded. The practice of creating and discarding embryos threatens to make us callously indifferent toward the creation of human life, transforming human procreation into a technological manufacturing process. We still know very little about how IVF and related technologies affect the health and wellbeing of the children created with their aid, and how they transform the relationship between the generations. As we move beyond questions of the moral status of the embryo, we must begin to turn to broader questions of biotechnology and the moral meaning of human reproduction.

Notes

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12. Vannevar Bush, *Science, The Endless Frontier: A Report to the President on a Program for Postwar Scientific Research*, Office of Scientific Research and Development, Washington, D.C., July 5, 1945, http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm.

13. Benoit Godin, "The Linear Model of Innovation: The Historical Construction of an Analytical Framework," *Science, Technology & Human Values* 31, no. 6 (2006): 639-667. Of course, Vannevar Bush's ideas can be traced much further back, to the very beginnings of modern science. Francis Bacon, one of the first to articulate the need and propose a shape for the modern scientific project, famously argued that science could provide useful knowledge that would allow the conquest of nature for "the glory of the Creator and the relief of man's estate."

14. The Nuremberg Code was first formulated in August 1947, following the trial of Nazi medical researchers for their war crimes involving unethical human experimentation. The Code, an internationally recognized set of standards, consists of ten directives to protect the rights of human research subjects, including rights to voluntary consent and prohibitions against experiments that are foreseeably likely to result in the injury or death of the subject. The Belmont Report was issued in 1978 in the wake of the revelations about the Tuskegee experiments. The Report was the product of four years of deliberation by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. The ethical principles articulated in the Report focus on four areas: "(i) the boundaries between biomedical and behavioral research and the accepted and routine practice of medicine, (ii) the role of assessment of risk-benefit criteria in the determination of the appropriateness of research involving human subjects, (iii) appropriate guidelines for the selection of human subjects for participation in such research, and (iv) the nature and definition of informed consent in various research settings." See *Trials of War Criminals Before the Nuremberg Military Tribunals under Control Council Law No. 10*, vol. 2, Washington, D.C.: U.S. Government Printing Office, 1949, 181-182, reprinted at http://ohsr.od.nih.gov/guidelines/nuremberg.html; *Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research*, National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, DHEW Publication No. (OS) 78-0012, Washington, D.C., 1978, available at http://videocast.nih.gov/pdf/ohrp_belmont_report.pdf.

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25. In 2008, the NIH implemented a new methodology for reporting research funding, which the agency used to recalculate funding figures for 2007. The Bush administration total funding figure of $294 million we report here uses this revised 2007 data, found on the new NIH RePORT website, along with the data found on the NIH Stem Cell Research website. NIH, "NIH Stem Cell Research Funding, FY 2002-2010," http://stemcells.nih.gov/research/funding/funding.htm; NIH Research Portfolio Online Reporting Tools (RePORT), http://report.nih.gov/rcdc/categories/.

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35. *Ibid.*, 8-9.

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human reproduction" (Diana DeGette, *Sex, Science, and Stem Cells: Inside the Right Wing Assault on Reason* [Guilford, CT: Lyons Press, 2008], xiv); and Mark Rasenick, director of the Biomedical Neuroscience Training Program at the University of Illinois College of Medicine, writing in the *Chicago Tribune* that "the Bush administration has sought to politicize stem cell research.…Science policy should be driven by science, not politics" (Mark M. Rasenick, "Stem Cells," *Chicago Tribune*, October 28, 2004, http://articles.chicagotribune.com/2004-10-28/news/0410280254_1_stem-cell-embryonic-cells).

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