Scientizing the Soul: Research as a Substitute for Moral Discourse in Modern Society

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I.

I want to begin by thanking you all for participating as subjects in the experiment. As a matter of full disclosure, I feel it only right to inform you that the experiment is likely to have very profound impacts on your life. These impacts may be quite positive—indeed, I presume that the anticipation of positive impacts explains why you are willing to take part. For example, some of you may find yourself considerably more wealthy as an indirect consequence of the experiment. But no one denies that the impacts may also be negative. Others of you may lose your jobs and find yourselves unqualified to find decent work. There is simply no predicting.

If asked to describe the experiment in one sentence, I suppose I would say that the it is an effort by hundreds of thousands of scientists and engineers to fundamentally transform nature and society through science and technology, with the ultimate goal of . . . . of . . . . well, here's where we run into trouble.

In the interests of openness I should tell you that the experiment does not conform to the standard methods of rigorous scientific experimentation. There is no control case. The experiment will go on, and we will see what happens. We will be unable to determine what would have happened had we carried out a different experiment, or no experiment at all. I realize this is unconventional, but society is not a petri dish. When you are transforming all of society, it is really quite difficult to design a control case.

Nor are the subjects of the experiment—that is to say, you, among many others—protected by the standard ethical safeguards typically used by the scientific community for experiments involving human subjects. For example, prior informed consent is not required of the participants. I have thanked you for participating, but that is really more of a courtesy, a formality, than an acknowledgment that you have made a free choice to take part. In reality, you have little choice in the matter. Moreover, if you become unhappy with how the experiment is proceeding, there is not a whole lot you can do about it. In theory it might be possible to opt out of the experiment, for example by moving to a remote place, or adopting the lifestyle of a hermit, but in practice few of you will be able or willing to do this.

The experiment deviates in other ways from accepted scientific norms. No one is really monitoring, in a systematic way, the progress of the experiment. Nor do we have a good system of measurements to assess whether the experiment is or is not succeeding. This leads to an additional point, that if the experiment begins to go awry, we probably won't know it, at least not until it's too late. But in any case, this doesn't really matter because the experiment is almost impossible to stop. And those most responsible for designing and carrying out the experiment insist that, under any

circumstances, stopping it or even slowing it down would be far more dangerous than letting it proceed.

Perhaps I can further clarify how the experiment works with an example. Let's say that some public laboratory or pharmaceutical company comes up with a new drug to cure some condition. They engage in an experiment—called a clinical trial—to see if the drug is safe. People like you voluntarily take the drug to see if it works, and all sorts of procedures to ensure the statistical validity and ethical acceptability of the experiment are supposed to be rigorously enforced. If the drug seems to be effective and safe, it is put on the market, at which point a much larger, but much less controlled experiment, involving perhaps millions, rather than hundreds, of voluntary subjects, takes place. Sometimes new problems turn up, and the drug is revealed to be unsafe. A notable recent example is hormone replacement therapy for menopausal women. Other times it turns out that the drug has beneficial effects beyond what is was designed for, and its use is expanded. In any case, this drug is now part of a pharmacopeia of thousands of drugs whose interactions and impacts cannot possibly be fully understood or predicted. In this way, the experimental process is gradually amplified from small, controlled experiments like clinical trials to the broad, ongoing, societal experiment in which we test the complex, unfolding consequences of all of our cumulative knowledge and ingenuity.

In some sense, it is fair to say that, at this broad, society-wide scale, the experiment is really just basic research, fundamental investigation into the question of what happens to humans and their surroundings when exposed to continuous, exponentially increasing rates of knowledge creation and innovation. Yet, as I've already suggested, our ability to assess and measure the cumulative results of the experiment are extraordinarily primitive, and limited to a few very indirect sorts of observations, such as changes in average per capita gross domestic product, or changes in the average temperature of the earth's atmosphere.

While the particular societal consequences of the experiment are unpredictable—in fact, that is what makes it an experiment—there are a few things we can say at this point. Most obviously, society fifty years from now will look very different than it does today, and these changes will dwarf those of the past fifty years. Accelerating trends in computer power and machine miniaturization coupled with advances in materials, energy systems, communications technologies, and robotics will transform all aspects of society, from the structure of manufacturing and industry to the ways that we acquire, transmit, and use information, and interact with our fellow humans. Advances in our ability to manipulate the genome of humans and other species will lead to enhanced power to intervene in developmental processes of individuals and evolutionary processes of entire species. Hybridization of computer technologies and human intelligence will lead to rapid increases in information processing ability of humans and a blurring of the boundaries between the virtual and the real, and between the biological and the electronic. As just one specific example, the inventor and technological visionary Ray Kurzweil believes that in the next fifty years: "Brain implants based on massively distributed intelligent nanobots will ultimately expand our memories a trillionfold, and otherwise vastly improve all of our sensory, pattern recognition, and cognitive abilities."[1]

[1] R. Kurzweil, "Promise and Peril," in A. Lightman, D. Sarewitz, and C. Desser, *Living with the Genie: Essays on Technology and the Quest for Human Mastery* (Washington, DC: Island Press), 2003, p. 51.

The experiment has profound moral implications, because it transforms the way we live and work and even think, because it creates winners and losers, and most of all because it is carried out by human beings making choices about the creation and use of new knowledge and technologies that profoundly affect the lives of other human beings—some of whom may live thousands of miles away, and have absolutely no idea that they are subjects in the experiment. The question I want to explore here is how we can talk about those moral implications in a society that is on the one hand committed to notions of democratic participation and on the other committed to visions of perpetual progress through continual technological change.

II.

Last May, United States President George W. Bush gave a speech in which he strongly criticized European countries for their opposition to genetically modified foods. He said:

"We can . . . greatly reduce the long-term problem of hunger in Africa by applying the latest developments of science. I have proposed an Initiative to End Hunger in Africa. By widening the use of new high-yield bio-crops and unleashing the power of markets, we can dramatically increase agricultural productivity and feed more people across the continent.

"Yet, our partners in Europe are impeding this effort. They have blocked all new bio-crops because of unfounded, unscientific fears. This has caused many African nations to avoid investing in biotechnologies, for fear their products will be shut out of European markets. European governments should join—not hinder—the great cause of ending hunger in Africa." [2]

President Bush's argument has three parts. First, science and technology can reduce hunger in Africa. Second, European countries oppose this science and technology because of "unfounded, unscientific fears." And third, this opposition thus contributes to hunger in Africa. The argument is inherently a moral one: Opposition to genetically modified foods is morally wrong because it keeps food out of the mouths of hungry people. But the moral error flows from scientific error, from "unfounded, unscientific fears." Morality is therefore a matter of technical correctness.

Two subtly different things are going on in this argument. First, we have a chain of logic which asserts that scientific beliefs are a sufficient basis for judging the morality of behavior. If you understand the science then you will support genetically modified foods and thus keep people from starving. But Bush's language also presumes that opposition to GM foods would be valid *only* if it were scientifically based. He does not allow that "unscientific fears" might be perfectly reasonable from other, non-scientific perspectives. Science is both the language and the measure of moral behavior.

I'll get back to the issue of GM foods later, but let me now bring up a second case, the dispute over stem cell research, in which President Bush has also played a role. Cells that are themselves capable of differentiating into one or more types of more specialized cells are called stem cells. Stem cells in the early stages of a human embryo's development are known as "pluripotent" because they can give

[2] Text of speech available at: www.whitehouse.gov/news/releases/2003/05/print/20030521-2.html (accessed on October 6, 2003).

rise to many different types of differentiated cells. Indeed, all of the specialized cells and tissues and organs in your body can be traced back to a bundle of undifferentiated stem cells that was you when you were just an embryonic glimmer in your mother's uterus. The hope and belief of medical researchers is that embryonic stem cells can be used to generate or regenerate tissues and even organs in the body that are in need of repair or replacement. Ultimately, the idea is that, just as we can keep airplanes flying safely year after year by replacing parts as they begin to wear out, we will be able to do the same for people.

But embryonic stem cells present a problem. They are derived from embryos, and research on them thus demands the destruction of embryos. This fact has roused the opposition of those groups in the United States who oppose abortion, groups who support and are supported by President Bush. The process also raises discomfort for others who may find abortion permissible but are uncomfortable with the idea of treating embryos as an instrument for medical use. As the President said: "Research on embryonic stem cells raises profound ethical questions, because extracting the stem cell destroys the embryo, and thus destroys its potential for life. Like a snowflake, each of these embryos is unique, with the unique genetic potential of an individual human being." But the President also noted that "research using stem cells offers great promise that could 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." [3] So early on in his presidency he found himself dealing with a moral dilemma: should the moral status of the embryo take precedence over the promise of scientific research to improve the lives of sick people.

He resolved the contradiction in a clever way—by agreeing that government-supported research could proceed on stem cell lines that already existed, because the process of extracting the stem cells had already destroyed the embryos. In the President's words, "the life and death decision has already been made." The German parliament has arrived at a similar decision in passing a law that restricts the importation of stem cells from other countries to those cell lines established prior to the passage of the law. This prevents German scientists from causing the destruction of embryos that are not already destroyed.

Now these two stories, about GM foods and embryonic stem cells, first of all illustrate how deeply intertwined moral and scientific issues have become. And we see two sources for this confluence. The first is the idea—an old one, by now—that scientific progress is in fact a source of moral good. The second reason has reared its head more recently, and that is the increasing capacity of scientists to manipulate the basic processes that give rise to life. And what I want to suggest is that the continued strength of the first idea—scientific progress as a source of moral progress—is making it very difficult for us to think clearly about and respond to the second idea: the capacity of science to change not simply the world around us but our own human essence.

Now the idea that progress in science and technology was directly and positively linked to the progress of humanity itself has its distinguished origins in Enlightenment thinkers like Bacon and Descartes but really came of age with the rise of the Western industrial economies in the 19th century. It has not loosened its grip since. Here's what the Nobel-prize winning Physicist Robert Millikan had to say in 1928:

[3] Text of speech available at: www.whitehouse.gov/news/releases/2001/08/print/20010809-2.html (viewed October 6, 2003).

"Could any man fail to reflect that our scientific civilization is the first one in history which has not been built on human slavery, the first which offers the hope, at least, of relieving mankind forever from the worst of the physical bondage with which all civilizations have heretofore enchained him. Within the past half century, as a direct result of the findings of modern science, there has developed an evolutionary philosophy which has given a new emotional basis to life, the most inspiring and the most forward-looking that the world has thus far seen."

Unchastened by the first World War and unable to conceive the second, Millikan still believed that human conflict would come to an end as science and technology created "a new world in which the old rules no longer work."[4]

And to some extend he was right. Two attributes of technological society are different from anything that came before. First, harnessing scientific knowledge and technological innovation to the market economy generated untold wealth, and the interests of wealth and power became inseparable from the interests of science and technology.

Second, progress meant change. Society has had to accustom itself to the idea of continual transformation at the hands of scientific and technological advance. Everything we use today, and much of what we know, will be obsolete before long. As Christopher Lasch explains: "We take our cue from science, at once the source of our material achievements and the model of cumulative, self-perpetuating inquiry, which guarantees its continuation precisely by its willingness to submit every advance to the risk of supersession."[5]. And we justify this process of continual change partly in the name of long-term economic betterment. Thus, for example, is the process by which thousands or even millions lose their jobs as economies modernize and become more productive termed "creative destruction."

But we also justify this change in the name of moral progress. Writing 70 years after Millikan, the philosopher Richard Rorty wrote that "the nineteenth and twentieth centuries saw, among Europeans and Americans, an extraordinary increase in wealth, literacy, and leisure. This increase [, which was directly attributable to the contributions of science and technology to economic growth,] made possible an unprecedented acceleration of the rate of moral progress."[6]

To some, the lessons of the past half-century or more may make Milliken's and Rorty's optimism seem ridiculous. Yet our overall societal commitment to a notion of progress that links science and technology to human betterment—both material and moral—has not waned, and has probably strengthened its hold on our political institutions, if not our private imaginations.

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[4] Robert Milliken, "Science and Modern Life," *The Atlantic*, April 1928, pp. 487, 491, 493.

[5] Lasch, Christopher, *The True and Only Heaven: Progress and Its Critics* (NY: WW Norton) 1991, p. 48.

[6] Cited in D. Jamieson, *Morality's Progress* (NY: Oxford University Press), 2002, p. 20.

Having made this brief excursion into the idea of progress, let me now return to GM foods. Remember that President Bush was able to claim that European opposition to biotechnology was based on unscientific beliefs, and use this claim to make an accusation of moral failure. What gives this strategy particular bite is that it is stands on the shoulders of international agreements under the World Trade Organization that allow nations to regulate trade in agricultural goods based on risks to human, animal, and plant health so long as such regulation is based on accepted scientific principles and standards. Science, that is, becomes the only legitimate playing field for disputing a society's ability to choose or reject GM foods.

The reasons for this are clear, of course. In the pursuit of more open global markets, nations want to restrict the avenues open to their trading partners to regulate imports. Obviously, the U.S., along with other nations such as Canada and Argentina, has a huge economic stake in opening up European markets to genetically modified foods. For example, U.S. corn growers are losing an estimated $300 million per year in export income due to European restrictions on GM foods. But the point is that Bush was able to defend these economic interests by invoking something much more compelling: the legitimizing force of science, and its implicit tie to moral progress.

Now I need to emphasize that I am NOT making a case in favor of scientific INcorrectness. When opposition to GM foods is based on ideas that are known to be scientifically wrong, it cannot be taken seriously. What I want to emphasize is that reasonable people may oppose genetically modified foods for reasons that are have little to do with science at all. Indeed, a research project on Public Perceptions of Agricultural Biotechnologies in Europe, or PABE, revealed that Europeans share a highly nuanced and complex set of reasons for generally opposing GM food imports, reasons that mostly reflect concerns about the processes by which this new technology is being introduced, rather than its inherent risks.

Along these lines, public opinion surveys reveal some very interesting aspects of European opposition to GM foods. This opposition is typically traced to a general distrust of government claims about food safety in the wake of the BSE and hoof-and-mouth crises. Yet, according to a 2002 Eurobarometer poll, in many European nations (although not the UK), the majority of people say that they would not purchase GM foods even if the foods were known to be safe, environmentally friendly, and cheaper than non-GM equivalents!! How utterly irrational. How could this possibly be??

If one looks at other public attitudes in Europe, an explanation begins to emerge. For example, 73 percent of Europeans polled believe that "Modern technology has upset the balance of nature;" 53 percent believe that "globalization is a real threat," only 16 percent agree that "what is good for business is good for the citizens," only 35 percent say that "private enterprise is the best way to solve our country's problems," and 80 percent say that "multinational companies are too powerful nowadays." [7]

What seems clear from the PABE project and the public opinion data is that European opposition to GM foods has nothing much to do with public misunderstanding of science and much to do with

[7] G. Gaskell, N. Allum, and S. Stares, "Europeans and Biotechnology in 2002," *Eurobarometer 58.0*, available at: europa.eu.int/comm/public_opinion/ archives/eb/ebs_177_en.pdf (downloaded October 6, 2003).

issues of political process, economic power, and social change. GM foods are the products of a few multinational corporations, they are disseminated through the mechanisms of a globalized economy, and people are distrustful of how these forces will influence their lives, their cultures, and their surroundings. It appears that the source of public opposition is not the GM foods per se, but their role in broader processes of social change that accompany the rapid proliferation of the products of scientific and technological advance: that is, The Experiment.

Yet—and this is a key point—the rules of the experiment, as codified under the WTO do not allow direct expression of these sentiments. People on all sides of the issue are thus forced to seek scientific language that can best support their underlying positions, a process that makes hypocrites of us all by forcing us to pretend that what we really care about is "the facts" as they pertain to "levels of risk." Democratic debate is consequently impoverished, because this charade does not permit us to openly discuss the real issues at stake and argue them on their own merits. Instead, experts for one side are pitted against experts from the other side in a battle of technical wits that few can understand and that may be largely beside the point.

IV.

The stem cell case shows another way that moral discourse can become captured by science. Some, perhaps most, medical researchers summarily dismiss any moral qualms about the destruction of embryos for the sake of science and medicine. For them, President Bush's solution—using existing stem cell lines but not creating new ones— is insufficient. According to Donald Kennedy, the editor-in-chief of *Science* magazine, the "scientific community remains unconvinced that the cell lines now available meet research needs."[8] Note that the implicit argument here is that research needs are the moral imperative. Indeed, Kennedy refuses to acknowledge that there is a moral dilemma at all, insisting instead that the problem is simply one of politics.

Other scientists, however, acknowledge a moral component to this issue and seek to resolve the dilemma through a combination of moral argument and scientific logic. The crucial questions have to do with when life begins and what constitutes a human. "What is a human being?" asks the German biochemist Jens Reich. "One logical answer," he writes, " is that individual life begins with the formation of the unique genome after the diploid chromosome set has been formed from parental DNA. This unique biological individuality is maintained through life. . . . But another answer is equally well founded. It says that the embryo in vitro is just a prestage that can spontaneously develop only until the blastocyst stage (5 days after fertilization) and cannot survive unless it has been implanted into a female uterus. Hence [implantation] is the decisive step to human life."[9] Indeed, it is precisely this distinction that justifies unrestricted access to in vitro embryos for scientists here in the UK, in contrast to the regulations of the U.S. and Germany.

But the biologist Robert Pollack, who also directs the Center for the Study of Science and Religion at Columbia University, is not confident about this way of thinking about the issue. He writes: "Many people—and I am among them—feel that the essence of anyone's individual unique value as a person cannot be reduced to 3 million base pairs . . . A common way—not the only way—to

[8] D. Kennedy, "Stem Cells: Still Here, Still Waiting," *Science* 300: 865 (May 9, 2003).
[9] J. Reich, "The Debate in Germany," *Science* 296: 265 (April 12, 2002).

express this strong feeling of being more than a mass of cells with a unique DNA sequence in each, is by the old Greco-Roman notion that located somewhere in each of us is an ineffable, non-physical presence, which we may call the soul. . . The entire technology for the production of embryonic stem cell lines depends upon a willingness to foreclose the potential of a fertilized egg or early embryo for the sake of the utility of its constituent cells. In these religious terms, that is the same as acting to destroy the physical home of a soul, thereby—depending on the particularities of one's beliefs—either sending it back to its Creator or destroying it as well." [10]

To Pollack, if you believe that the essence of an individual human resides in a soul, you cannot define that soul away based on the developmental stage of an embryo. Thus, he offers another solution to the stem cell problem: rather than sacrificing an embryo, you could take an unfertilized egg cell donated by a woman, remove its nucleus, and insert a nucleus from a cell taken from a different person. Such an engineered egg could, in theory, produce stem cell lines with the genetic characteristics of the nucleus donor. This egg is not a bona fide embryo, however, because it was not created from the fusion of egg and sperm. However, the engineered egg could develop into a person—in fact, into a clone of the nucleus donor—if it were implanted into a woman's uterus. Pollack's argument is that so long as the egg is not implanted, no soul would be at risk.

V.

This type of angels-on-the-head-of-a-pin argumentation makes it almost impossible to step back and ask a big question, like: Why are we doing this research in the first place? Of course there are sick people out there who might ultimately benefit from stem cell research, but how should we be choosing which science to focus on, which problems most merit our attention. In the U.S., where, for example, white Americans outlive black Americans by about 6 years on average, should we expect that the life-extending capacity of stem cell research will simply add to this imbalance, and thus further entrench the social inequalities that have plagued our nation since its inception? In Europe, where the population is aging and the economic viability of social programs comes under increasing pressure, is extending life expectancy to a century or more the solution to a problem or the cause of one? The moral dilemmas implicated in these types of issues are huge, yet we on the one hand shield our scientific enterprise from the rigors of moral debate in the name of free scientific inquiry, and on the other demand that our moral debate be regulated by the language of science in the name of intellectual rigor or economic freedom. The result is a highly restricted domain of permissible conversation, and an increasing willingness to stake the future of humanity not on our admittedly imperfect processes of negotiating competing values and interests in light of our moral foundations, but instead on the accelerating capacity of science and technology to remake the world in any and every way that it can.

A key question for this century—perhaps the key question—is whether democracies will have the self-confidence to question the combined power of science and markets and assert a stronger governing role over science and technology in charting society's path. The trends here are not favorable. For example, in the case of GM foods, most activist groups have bought into the notion that the debate should be centered around the question of risk and carried out on a technical playing

[10] R. Pollack, "Stem Cells, Therapeutic Cloning, and the Soul," speech to the George C. Marshall Foundation Roundtable, Washington, DC, October 17, 2001, available at: http://www.crosscurrents.org/Pollackspring2002.htm (viewed October 6, 2003).

field, thus compromising their capacity to make independent arguments based on values, culture, and ethics. In the case of stem cells, the promise of concrete benefits is likely to motivate much more fervor than fuzzier concerns about social implications. In the U.S., disease-focused special interest groups have exercised enormous political muscle in promoting medical research. As the neoconservative commentator Charles Krauthammer observes: "Those resisting [stem cell] research will find themselves outflanked politically, as the stampede of the incurably sick and their loved ones rolls through Congress demanding research and treatment." [11] I should add that opponents of the research will also be resisted by the pharmaceutical industry, which foresees huge profits, and they will be labeled as ignorant luddites by the scientific community, which wants no restrictions on its research agendas or funding.

So the question of whether democracy will be part of the problem or the solution remains to be seen. Perhaps it has always been thus, and we are destined to live in a world where our democratic institutions and our public discourse are constantly struggling to keep up with our technical ingenuity. But I am inclined to take seriously the indications that, if such a delicately balanced asymmetry ever did exist, scientific and technological advance is now on the verge of leaving democracy in the dust. The GM food and stem cell stories are perhaps indicative of this change.

When a conservative political philosopher like Francis Fukayama writes a book which argues that human biotechnology is a threat to fundamental human values, and advocates government regulation as the answer, it is time to take notice. When a technologist like Bill Joy, who designed much of the software architecture of the information revolution, gets worried that the convergence of nanotechnology, biotechnology, and robotics may create significant threats to survival of our species, it is hard to ignore. When a scientist of the stature of Martin Rees writes a book called *Our Final Hour* in which he predicts that an act of bioterrorism will kill at least a million people in the next 20 years, and rates humanity's chance of surviving the century at about fifty-fifty, we might want to listen.

Of course I realize that history is littered with foolish technological predictions of both the utopian and dystopian sort, but there is good reason to believe that the capabilities of science and technology are now on the verge of something entirely new, made possible by a growing ability to manipulate matter at the atomic level to achieve specific functions. This ability will be applicable to the inanimate and the animate, to the structure of an aircraft, a computer, a brain, a gene. As Krauthammer argues: "The real problem with research that manipulates early embryonic cells . . . is not the cell's origins but their destiny. What really ought to give us pause about research that harnesses the fantastic powers of primitive cells to develop into entire organs and even organisms is what monsters we will soon be capable of creating." And as a biotechnologist recently remarked to me: We will soon be able not only to enhance memory, but to implant memories of things that never happened—and erase memories of things that did.

What's particularly interesting here is what I take to be a very gradual migration of some very thoughtful people, people who are spread all over the ideological spectrum, toward the idea that we might want to think about modulating the pace of change, so we can figure out what, exactly, we are doing to ourselves in the course of our great experiment. More than thirty years ago, the philosopher

[11] C. Krauthammer, "Why Pro-Lifers are Missing the Point," *Time*, February 5, 2001, p. 60.

Hans Jonas laid out the argument for how we might think about this modulation. "Progress," he wrote, "is an optional goal, not an unconditional commitment, and its tempo in particular, compulsive as it may become, has nothing sacred about it. A slower progress in the conquest of disease would not threaten society, grievous as it is to those who have to deplore that their particular disease be not conquered, but that society would indeed be threatened by the erosion of those moral values whose loss, possibly caused by too ruthless a pursuit of scientific progress, would make its most dazzling triumphs not worth having."[12]

So I will end here at what is really the beginning of another discussion: how might we actually consider governing this experiment of which you are all a part? Predictably, there are those who say we must leave the science to itself and to the markets. They are quite capable of governing themselves, thank you. This seems imprudent in the extreme. Imagine if we had followed this course for nuclear weapons. On the other hand, I have yet to run across a responsible voice who advocates the opposite course of stopping the advance of science and technology. It is obviously impossible, and in any case unthinkable. Humanity is utterly dependent for its survival on science and technology, and there is no getting away from that reality.

The question is how, given the stunning advances now on the horizon, we can mobilize the intelligence of democracy to situate ourselves between these two extremes in a way that gives us a decent chance to keep up the serious struggle of building a just and free society. That, of course, is the hard part, so I leave it to the succeeding speakers to give you the answer.

[12] Cited in: D. Callahan, "Is Research a Moral Obligation," available at: http://bioethicsprint.bioethics.gov/background/callahan_paper.html (viewed October 6, 2003).