



## **Do We Want Science to Reinvent Human Aging?**

*Gregory Stock, UCLA*  
*Bill McKibben, Journalist*  
*Morton Kondracke, Moderator*  
*March 27, 2003*

**KONDRACKE:** The formal title of today’s debate is “Do We Want Science to Reinvent Human Aging?” but I might say that the informal title of the debate might be, “Do We Want Science to Reinvent Human Beings?” The person who says yes is Gregory Stock, and his book is entitled *Redesigning Humans: Our Inevitable Genetic Future*. Greg Stock is the director of the Program on Medicine, Technology, and Society at UCLA’s School of Medicine, and in this role he explores critical technologies poised to have large impact on humanity’s future and the shape of medical science. His goal has been to bring about broad public debate on these technologies and their implications on public policies.

Bill McKibben graduated from Harvard University in 1982 and became an editor at the *New Yorker* magazine; his work has appeared not only there but also in the *Atlantic*, the *New York Review of Books*, the *New York Times*, *Natural History*, *Rolling Stone*, *Esquire*, and *Audubon*, among many others. After five years at the *New Yorker* he decided to leave the frantic pace of urban life and move to an isolated house along with his wife in the Adirondack Mountains in New York State. Now he also spends time in Vermont, where he says he has cross-country skied for 116 days this season. Our question today is: do we want science to reinvent human beings? and Bill McKibben’s answer is no. His book-length exploration of this subject, which was recently published, is called *Enough: Staying Human in an Engineered Age*.

Our format is that this debate is going to last an hour. Greg Stock will begin with a ten or twelve-minute exposition of his point of view, followed by Bill at the same length, then there will be some back and forth which I’ll try to encourage with questions. We’ll go on until we get so many good questions from here in the studio audience or out there in cyberspace that we can just do the rest of the program answering your questions—so we invite your questions. Those of you who are watching this online, there is a place on the Web site, which should be clear to you, on how to e-mail your questions, and we’ll be glad to have you participate. With that, let Greg Stock begin.

**STOCK:** Thank you. It’s good to be here. Bill McKibben and I have very different visions of the future. We don’t differ so much about the significance of the possibilities emerging from the revolution of biotechnology today, as about how to navigate the terrain ahead. I think that we have to be extremely cautious about regulating these technologies, and that legislation based on abstract fears about the future would be a big mistake. Moreover, I believe that we already have adequate structures in place to protect against the immediate dangers at hand, and that we already have adequate mechanisms in place to respond to the kinds of challenges that are likely to arise from the various concrete problems that will undoubtedly emerge as we use these technologies.

We have to consider the extraordinary nature of what is going on today. We are unraveling the fundamental workings of biology, coming to understand what makes life tick. Of course we’re going to try to use this knowledge in ways that we think will enhance our lives. Of course there are going to be applications of this knowledge that will be troubling and challenging to us and that will create a lot of angst. These are profound

developments. They're going to revolutionize health care and medicine; they're going to change the way we have children; they're going to alter the way we manage our emotions; and they are probably going to alter the human life span. These are very, very challenging developments, and I think that the possibility of altering the aging process itself provides an excellent example of the larger challenges ahead. We could be talking about designer children, or we could be talking about psychopharmacology, but I think aging is the most interesting, because if we in fact are able to retard, and perhaps even reverse, some aspects of this process, the impacts upon us will be so enormous.

I don't think any other technological advance will affect our lives as profoundly, and I think it's very likely that this will occur. Indeed, I'd like to nudge it forward a bit. If I have a choice of being among the first generation to experience the benefits of extended human health span and prolonged vitality, I'd prefer that as opposed to being among one of the last generations not to have the advantages of those possibilities. And I suspect that Bill McKibben would come down on the opposite side of that.

Before looking at aging in particular, though, let's step back and take a look at where we are. It's important to do that, because otherwise it would seem that there really might be a possibility that we could just say "enough" and stop these technologies. But what is happening is unprecedented in the history of life, and there is no brake to put on. There are two revolutions occurring; the first is the silicon revolution. We've seen the Internet and telecommunications, and the way these various technologies are changing our lives. We have taken the inert sand at our feet, the silicon, and we have breathed a level of complexity into it that rivals that of life itself. This is a breakthrough that is going to mark a transition in the history of life, and it will always be seen as such. The second revolution is a child of that development, and it will have even more impact on us. This is the revolution in biological sciences, the genomics revolution, the unraveling of life. Essentially we are beginning to intervene in that realm and take control of our evolutionary future, which is obviously going to have huge impacts. Bill's idea of now saying "enough" is an interesting hope, since we're really just beginning.

Let's return to aging and consider the consequences of interventions that would retard or even reverse key aspects of it. The questions are easy and lots and lots of people have asked them and worried about them: Is this going to divide society? Is it going to bring about the loss of our values? Is it going to create intergenerational conflict? Lead to a population explosion? We can throw away all of these questions, though, because the answers are unknowable at the present. They depend on technologies that still are in the future and will be brought to bear on these issues. Aging is multifaceted, and different aspects of it are going to be dealt with in different ways in different cases. So would treatments for aging have side effects that are serious? Will they need frequent repetition? Are they going to be arduous? Are they going to take a long time to act? Are they going to have to begin before a certain age, perhaps even in embryo? Are they going to reverse aging or simply slow it? You can capture a number of these possibilities by looking at the fixed and variable costs, the general development and overhead costs of the interventions as opposed to the costs per person for the procedures. If anti-aging interventions emerge, are they going to be the kinds of things that can be rolled out to large numbers of people

relatively inexpensively? If so, then there will be huge political pressures to make this happen. Or are they going to be very high-cost and very personalized and very difficult? In which case there will be a much narrower subset of the population that has access to them, which would present a host of other problems.

Not everything that can be done should or will be done. But when you take something like this that is likely to be feasible in thousands of laboratories throughout the world, something that is seen as beneficial by large numbers of people—which is clearly the case with anti-aging medicine, judging from the way people do cosmetic surgery and vitamins and such—something that’s almost impossible to police (and in fact how are you going to punish somebody? Are you going to force them to eat French fries and smoke cigarettes?), it’s not a question of *if*, but *when*, and where and how this will arrive.

I think it’s absolutely certain that humanity is going to go down this path for two reasons. The first is that it’s just the natural spin-off of all the mainstream medical technology that virtually everyone supports, and secondly because we’re human. We try to use technology in order to enhance our lives in a variety of ways, and to imagine that we won’t go down this path if we can is every bit as much a denial of what the past tells us about who we are as it would be to think we would go down this path without agonizing about it and fretting a great deal. I think that there will be a lot of that as well, and that Bill is a good example of this. The lines are blurring between therapy and enhancement, between treatment and prevention, and between need and desire, and they are going to continue to become ever more blurred as we move forward.

We could try bans; we probably will in a variety of realms, but ultimately this is not going to stop this development, it’s merely going to drive it from view, preserve the technology for the wealthy, shift it overseas, and even more importantly, raise the dangers from these technologies by denying us the information we need to use them wisely. There are going to be mistakes, there are going to be challenges, and it would be best to make those when very few people are involved, rather than later when they are being rolled out broadly.

It’s critical to realize that you can’t just sit back and reflect on these sorts of possibilities and think that you’re going to come up with the best path forward. You have to buy this knowledge, and you have to buy it through experience, through mistakes, through dealing with the various challenges that arise as we begin to use these new technologies. The critical thing is to put the mechanism in place that will enable us to obtain this information as rapidly as possible. These new technologies are no ticket for utopia, but I think that the benefits far outweigh the risks, that humanity will explore these realms, and that our next frontier is not space, but our own selves. To me the challenge facing us is not how we handle genetically modified foods or cloning or any other specific technology, like anti-aging medicine, it’s whether we will continue to have the courage to embrace the possibilities of the future or whether we pull back out of fear and essentially turn over their development to other braver peoples in other regions of the world—many of whom, of course, will have values that are very different from our own.

It's important to realize that there will be no consensus about these issues. Lots of people say, "Well, let's just slow down and debate and discuss it until we reach consensus." It's not going to happen. These things touch us too deeply. They touch our values too deeply. They depend upon religion, upon philosophy, upon politics, upon culture, upon personality. In fact, some people are going to continue to see them as the invasion of the inhuman—the worst possible thing that could happen to humanity—and other people are going to say "this is the flowering of human endeavor, this is incredible, this is stuff that previous generations could only dream of." Of course we're going to go out and use this.

It is very important in the debate to realize that this is not like nuclear weapons, where someone is going to misuse the technology and billions of people are going to be injured, or even vaporized. As long as we guard our political institutions and freedoms, we will have a way of protecting ourselves from biotechnology.

The biggest danger is not that we're going to move ahead too rapidly, but that because of misguided legislation, we will actually injure large numbers of people indirectly by delaying might-have-beens that will come too late for those today with serious diseases. It's very easy to dismiss these injuries-of-omission associated with misguided policies, because they are a bit in the future and it is not quite clear who's going to be affected, but it will be very clear to those people at that time, and we should not ignore this.

**KONDRACKE:** Thank you very much Greg. Bill McKibben, you have time for your response, and I hope that in your response—I know that this is a key part of your book—you will explain what some of these technologies are that Greg alluded to, and perhaps at least describe them for the benefit of those in the audience in lay language.

**MCKIBBEN:** Absolutely. Thank you Mort, and thank you Greg. It's a pleasure to be here, although, I must say to be on the side of death and aging seems a hard task. I think that Greg Stock has written a fascinating book on these questions and done much interesting speaking and thinking about them and is being too modest in his description of this whole idea that we should just wait and see what happens and what comes down the road next. I mean, it's very clear what people are talking about and what he's talking about. He's made it clear in his work that the intents to reverse and conquer aging will be the first things that may well tempt us to do germ line engineering of human embryos. Other people working on these issues have said much the same thing and talked about cloning of human body parts—like Michael West, the CEO of Advanced Cell Technology—the kind of immortality and things like that.

As I say, this all feeds into one of the oldest dreams of human beings: the idea that we might, if not completely conquer our mortality, certainly delay it dramatically. In fact, many of the people doing this work are all for conquering it entirely. I take some comfort in my worries about this when I consider that those people throughout history who have considered it most closely, who have done the deepest literary attempts to understand what it would mean to approach some sort of immortality and quasi-immortality, have come away scared, and beyond scared—horrified—as if they have peered into the abyss.

Let it be said that we are not talking about cancer treatments, etc., that kind of thing. I mean, if we are, then we have no grave debate between us. Those things that would treat diseases to which we now fall victim and that would attempt to make us healthier through what is now the normal course of human life hold no problems for me. The interesting question is whether or not we should attempt to extend human life beyond the sort of life span that we see now, a maximum life span of something like 115 years—what scientists and biologists have called the Hayflick limit, the number of cell divisions that happen before we in essence wind down. It is that that we really and deeply would consider and that professor Stock considers in great depth in his work.

First of all let me say just in passing—we can get back to this—that the idea that this will be the first thing to tempt us into using germ line engineering is an important thing not to pass over quickly. One of the points in my book is that all of the uses of germ line engineering lead us into potentially deeply troubling acts. In fact, by their very nature they lead us automatically into troubling acts. Professor Stock has proposed that people might want to redesign their children so that they will be more religious or more musical or more optimistic or things like that. I think down that path lies the death of what we call human meaning, the idea that people are in some way their own human beings and are not pre-programmed semi-robots of some kind.

But let's talk more directly about aging, because abolishing death, or at least dramatically postponing death, is a very good example. I'm willing to concede to Professor Stock and his allies that it may well be possible at some point. But if it does become possible, it will be the most fundamental shift imaginable in the course of human history. It will not be a small extension of some other thing; it's not like developing a treatment for Alzheimer's or some other condition, it's something of an entirely different order. We call ourselves mortals for good reason; in many ways that is our single most important defining characteristic—more important than the opposable thumb or the idea that we are the creature that knows that someday we will perish upon this earth. Without it, it would be a world where we live farther and far longer, where we, in Professor Stock's vision, double, triple, quadruple, maybe sextuple our life spans or where we're able to clone new organs and keep ourselves alive forever—to use the more far-out visions of some of the nanotechnologists and the people really interested in what Professor Stock has called the “silicon revolution.” If the day comes when we can ensure some kind of immortality through some link with that silicon universe, then we will be something completely and utterly different, and with that shift will come, I think, a kind of meaninglessness. In a life like that, time would have very little meaning. The idea that for each thing that there is a season, or that there are choices to be made, would begin to disappear; the rhythms that have marked our lives would begin to disappear, and the sadness is not those things themselves, but that with them they will take much of the possibility for human maturation, which much more than anything else is the proper role of the human life.

The arresting of aging is in some ways the arresting of maturation; the destruction of that force, our own knowledge of our transience, that leads us in some ways to grow up, to not put ourselves at the center of the universe forever. In its wake it leaves, I think, a kind of pervasive selfishness. Let me quote briefly from Dr. Michael West, the CEO of

Advanced Cell Technology, who is on the cutting edge of this sort of work. Asked about these sorts of questions of immortality, he outlined for his interviewer a long list of the many things that would make it possible, and in his view desirable, for this to happen. The interviewer asked him about whether or not it would create practical problems in terms of things like population. He alluded as to how it would; in fact, the world would begin to fill up and all of you can figure out the practical problems, I don't want to dwell on them. But a universe in which you spend eighty percent of your life belonging to the AARP, would be a crowded universe eventually. I don't want to focus on the issue because I'm not sure what the answer is, but what interested me was the way that he said it: "Why put the burden on people now living, people enjoying the process of breathing, people loving and being loved?" The answer is clearly to limit new entrants to the human race, not to promote the death of those enjoying the gift of life today. Now, today. He and his colleagues want to stop time, but you can't enjoy the gift of life forever. Maybe with these tools we will in some way learn to live forever, but the joy of it, the meaning of it, will melt away like ice cream on an August afternoon. I guess what I am trying to say is that I think that life far beyond the parameters of what we know now, life that goes beyond the normal human expectations, may be very much like a trap, and the name of that trap is a very American one—the constant idea that more is better. If it is good to live 80 years, it must be better to live 180 years and far better yet to live 300 years.

In the first place, just from a completely utilitarian point of view, it's not entirely clear that this even leads to more. In many ways more is not always better. There are questions that are thresholds instead. I mean, we're going to go out to dinner tonight and if we have a beer or two that would be pleasant, and if we have eight or nine that would be a mistake. There are plenty of cases in which more is not better, and one of the facts of growing up is beginning to realize which things fall into this category. I'll end it there so that we get to questions, except to say that I think that one thing not worth debating, not an important part of this debate at least, is the idea that things are inevitable. If things are inevitable, then there is no reason to debate them or write books about them, have forums, have Web casts, interrupt the course of our afternoon, whatever else. It's the very fact that things aren't inevitable that makes them interesting; the very fact that we need to debate them. Professor Stock said at one point that the consensus will never emerge; if by consensus we mean an absolute unanimous agreement about things, that's obviously true. But, if as in a democracy, we mean a working majority who will pass legislation and act responsibly, then clearly over time in some way or other that could emerge, and that's precisely the direction to which eventually all this should be heading.

**KONDRACKE:** Professor Stock, would you explain to our audience, for the benefit of those who don't understand it, briefly and as simply as you can what germ line genetic engineering is and any other emerging technologies that you think are relevant to this issue? I know that you refer to something called "fyborgs," which are like bionic cyborgs but they're different, that's an area of exploration that you talk about. So what are the technologies exactly and how imminent are they?

**STOCK:** Before I respond to a few of those points, the kind of technologies that we're talking about in a larger sense are things called germ line engineering, which is the

alteration of the germinal cells—as in the germination of a seed—so it’s actually going into the first cell of an embryo and altering the genetics of that cell. And that’s not so distant, though it is probably at least a generation or so away. Another analogous technology, and it exists today, and it again has to do with embryos, is to screen them. You take a six-cell embryo, remove one of the cells, run a genetic test of that cell, and depending on the result, decide whether to implant the embryo or discard it, and that’s here today, at least for a number of genetic diseases. We’ll soon be able to make screenings based on personality traits and non-disease traits. There are all sorts of pharmaceutical interventions that one could imagine to alter aspects of aging as we understand the biological basis of it, but the specifics of future technologies is something we can only see with very blurred vision. We can’t see very far, and so that’s why there is a bit of nondiscreteness here about what we’re talking about.

I want to respond to a few of the points that Bill made. I think they show one of the problems associated with this important discussion. And the discussion is important, because it is a way of getting us to grapple with these technologies, and not to decide whether we can stop them or not. If we determine that these developments are going to happen—and I think that is very clear—there are still are many different paths open to us, and some of them will be much more painful to us than others. So it matters if we think that we can turn back these technologies by blocking embryonic stem cell research or other new technologies.

Bill may say, “Well I’m not talking about any sort of disease, I agree with those sorts of things, even though I disagree with extending our life spans,” but these two realms cannot be separated because as we unravel the processes of life in biomedical technology—which is the way we are going to fight diseases—we open up all sorts of other possibilities. Some critics might assert that the only way to block these possibilities is to try to sift through the research and find the developments likely to have substantive impacts on biomedicine today. This is the situation with embryonic cell research.

The discussion of immortality is very interesting because of how quickly people move from the idea of expanding life span or health span to suddenly gaining immortality with all of the attendant trauma. You can make an argument, if you’re going to talk about human immortality, that if you triple human life span you haven’t even gotten close because 85 over infinity is about the same as 250 over infinity. Face it: immortality is something far beyond what we’re talking about.

**KONDRACKÉ:** What do you think the practical reasonable limits are? How close to immortality is it thinkable to get?

**STOCK:** If you did not suffer any aging whatsoever and had the vitality of a teenager, then deaths from accidents alone would bring life spans of about one thousand years. So, visions of immortality are not a good foundation for real-world public policy discussions.

**KONDRACKÉ:** A thousand is pretty close.

**STOCK:** That is if you had no aging whatsoever. If you're going to say, well, we don't want to extend the human life span because of problems of population growth and various other issues that might arise, or problems of the human spirit, then I think you really have to examine whether in fact you should be working on extending the human life span at all by treatments of Alzheimer's and all sort of diseases of aging. There is a blurring between treatment and prevention, and between therapy and enhancement. If you in fact could alter the aging process so that people live a bit longer and do so in a healthier fashion, well that is going to look very much like preventative medicine for the diseases of aging. But bit-by-bit, we are likely to move towards greatly extended life spans. The two are going to be essentially equivalent, so the question is not whether we're for immortality, but whether we're comfortable with healthier, longer lives.

**MCKIBBEN:** Leonard Hayflick, who you know is the godfather of aging research, said not long ago that if you manage to cure all the causes of disease that are on every death certificate there was, you would extend human life expectancy less than we have in the course of the last century through public health measures.

**STOCK:** Less than forty years.

**MCKIBBEN:** It would be much more on the order of twenty years. If you got rid of cancer and heart disease, then you've only expanded average human life expectancy five to six or maybe seven years. Those sort of things I don't think people have—I don't know anyone who has great difficulty with them. People, say, at conferences you've organized, have talked about living to be a thousand, or indefinitely, and about crossing over to some new world, and to pretend that that is not something one should take seriously or think about is to muffle the impact of your own work.

**STOCK:** First of all, Leonard Hayflick's idea that the maximum number of divisions that a cell can undergo has much to do with organismic aging in higher animals is not something that most people that I know in biology of aging subscribe to. So this distinction is kind of a red herring.

**MCKIBBEN:** What most people agree is that 115 or so is where we max out.

**STOCK:** There is actually a lot of disagreement about that. There is certainly an aging process that is occurring. But what I'm trying to say is that it's great to talk about immortality, but in fact we're dealing with real lives in the real world. So when you say, "Well, we don't want to be immortal," what does it mean? If you're just saying "Well, I have a lot of angst about that and I think we should relinquish these technologies and not think about them or not support them publicly or whatever," that's one thing. I don't think it will have much of an impact on medicine, but it's a great discussion to have. But if you're saying, "Well, I really want to stop these technologies because I'm afraid of immortality," the only way you can really do that is to intervene in the realm of biomedical research that is directed at real people with real diseases today.

**MCKIBBEN:** Let's talk about things like germ line engineering, which most countries in the developed world have now decided they don't want to pursue and have had some bans.

**STOCK:** And you would ban it?

**MCKIBBEN:** I would, but I wouldn't ban stem cell research. I think that stem cell research is being held hostage at the moment by people who want to go ahead and eventually do germ line engineering and who are unwilling to work out the compromises necessary to let it go forward in a good way. That is to say, it's completely possible to imagine stem cell work where you look closely, regulate it closely enough that human reproductive cloning is not much of a danger. But working out that kind of a system in some way, like, say, what the President's Council on Bioethics has proposed doing, is precisely what a lot of researchers have refused so far to do.

**KONDRACKE:** I thought, though, from reading your book that you are against therapeutic cloning?

**MCKIBBEN:** No, you thought wrong. What I'm against is going down that path before we put in place all the safeguards necessary to make sure that it doesn't become reproductive cloning.

**STOCK:** Well how could you put in all the safeguards that are necessary? The technological process is basically the same.

**MCKIBBEN:** That's right, you'd need to have very, very careful regulation and monitoring of all the work that is being done, just in the same way that we've been having a chemical industry without also producing chemical weapons.

**STOCK:** So let me be more concrete. You've said you don't like the idea of germ line intervention, which is operating on an embryo. Now we've been talking about aging—and we can get back to germ line interventions because I see that as being a natural outgrowth of a whole number of other screening procedures. In my view, if you're going to repair genes or select an embryo that does not have a defective gene, it's an engineering choice. But let's set that aside and talk about anti-aging medicine. It's possible that germ line interventions will be necessary to greatly extend the human life span. But that's not really very interesting to most people who are already adults because they've passed the stage where you can intervene in the embryo. So most of the research of the Michael West's of the world are directed toward adults, quite simply because he and others would like to see benefits that could be applied to themselves, and most people are beyond the embryonic stage. So what would you propose as things they could actually do to stop this, other than the rash of legislation surrounding stem cell research?

**MCKIBBEN:** Let me say first of all that your notion that germ line engineering is somehow a small part of this or some instance—the second sentence of your chapter on aging says, “In light of our yearnings for immortality the underlying biology of aging

may well be the first germ line intervention to truly tempt us,” because everything else will have only very, very modest effect.

**KONDRACKE:** Which is to say that you would discover what the genetic causes of aging are, and you would tinker with the genes for ever after in embryos and eliminate the aging process for that baby and all that baby’s progeny.

**STOCK:** Putting genes in place that could be turned on and off at a later time by the adult to operate against some of the processes of aging might be the only possible way of intervening.

**MCKIBBEN:** You predicted it would.

**STOCK:** I think that such an approach will be used, but you’re jumping over a whole mountain of effort that has to do with anti-aging medicine in adults. If it turns out that you need to do embryonic interventions in order to gain significant life extension, that will be profoundly disappointing to virtually all of the people that you have cited, and to those doing the kind of work to which you are referring. I’m not against germ line intervention, I think that it will occur—but what I’m saying is that as for anti-aging medicine, the work that you believe might lead to germ line intervention, how would you stop it?

**MCKIBBEN:** I’m not here to write the series of regulations. There are people who are more adept at that. This series had Frank Fukuyama a few weeks ago; this is his specialty. I am interested in the sort of deeper question of whether or not this is a path that we want to go down. If all we’re going to talk about is whether or not we’re going to do some more work on Alzheimer’s, then I don’t think there’s going to be much debate. Why don’t you want to engage these questions that you’ve opened up so dramatically and powerfully in your own work? Questions about this future where we’re engineering people not to age, we are engineering people so that they will be more religious, or we’re engineering people so that they’ll be more optimistic, or we’re engineering people so that they’ll be more musical or faster or smarter?

**KONDRACKE:** In addition to the aging issue you would say, I think, that it is fine that we develop basically super-people where everybody’s kids would be Michael Jordan.

**STOCK:** I think that that is a misunderstanding of what enhancement is likely to be. In that people always think of super-humans and blond, blue-eyed sort of rendition of the Nazi eugenics?

**KONDRACKE:** I was thinking Michael Jordan.

**STOCK:** OK, in Europe they might talk about this, these evocations of Hitler. But what I think is most likely to occur is that yes, parents will make choices about personality, about temperament. Let’s take real simple ones that are available today: Parents can make choices, and do make choices, about the sex of their offspring. Now I don’t know what

you're feeling is about this, but Francis Fukuyama and many, many other people say that it is inappropriate, that a parent should not be able to make those sorts of choices. But I say, if a couple wants to have a boy or a girl, for some particular reason, who is a child of the gender they choose, and equally, if a couple feels that they would have a certain resonance with a child of a particular predisposition—let's say they have a tendency to sleep through the night—I don't see a problem with that, although you can argue that this would somehow corrupt the relationship between parent and child. I would say, well, what about birth control? I mean, we have profoundly altered the family using birth control. We have essentially separated reproduction and sex, and nobody talks about that. I think it can be seen in very much the same way.

**MCKIBBEN:** I think that argument, that deciding when you are going to have a child is the same as deciding whether or not that child can be programmed to be pious or not, is a logical leap that would defy super-human.

**KONDRACKE:** Bill, let me ask a question here. Do you oppose genetic screening?

**MCKIBBEN:** I don't—with a set of caveats. When confined to a set of genetic illnesses that society decides is worth screening for, then I don't oppose it.

**STOCK:** You would oppose selection for gender.

**MCKIBBEN:** I would. And I would oppose selection for intelligence and blondness and height and all those things as well. I think down that path lies a very different society in the ways that people have talked about divisions in society between rich and poor; that's all true, and all things that Francis Fukuyama has written about are very true and telling. But at an even deeper level, it presupposes an entirely different idea of what a human being is and what the relationship between human beings is going to be.

One of the things in my experience being a parent, one of the glorious things about it and one of the things about it that causes you to become a fuller human being, to mature, is that at some level you weren't in control of this process, that the person who emerged was not your catalog choice of things. You didn't go into a clinic and say, "I want..." The notion that this is a good idea and that people will go for it is perhaps at least in a few cases true. I mean we live in a society where everybody is busy injecting botulism toxins to wipe out wrinkles. On the other hand, if we think about it a little, we'll see the kind of logical fallacies. For instance, if you engineer your child today, and in fact Professor Stock sort of alluded to this, you give them the best gene package available, up their IQ twenty points and then research goes on. Ten years later you're ready to have your second child and there's a whole other set of better software available to plug in. Now you're giving them forty IQ points and their muscle mass is twice as big. Well, your first child is now just like Windows 95. What kind of world do you enter into when you begin to do this?

**STOCK:** It's very interesting because you assume that you're going to really be able to do dramatic enhancements beyond the envelope of what is considered human potential

today. I think that that may come, but that is a technologically challenging development that's very difficult.

**MCKIBBEN:** You were the one who explained how Bill Gates' child in thirty years would be able to engineer far better than anything the richest person on earth could afford now.

**STOCK:** I said that divides are likely to occur between one generation and the next, just like with technologies of computers or such, and that the richest person in the world could not purchase anything that was even akin to what anyone can get today.

**KONDRACKE:** But there is no question, is there, that rich people would have this technology available to them? The richest people would ensure that their kids went to Harvard by raising their IQ in vitro and maybe get an athletic scholarship to boot, and poor people would be left behind and would be some sort of subspecies.

**STOCK:** No, the distortion here is basic. I made that statement about Gates, but I did not say that he would be able to choose superhuman traits. That is the hardest thing to accomplish. Let's just take something very simple to illustrate this. It's very difficult to imagine, but if you were going to try and engineer a human being that was eight feet tall, it would be very difficult because you'd have all sorts of physiological problems, things that wouldn't work well. But if you wanted to increase the height of someone, say a boy who was going to be five feet tall or four foot six, and bring him up toward average height or a little bit above average, that would be relatively easy. So these kinds of interventions in the foreseeable future are much more likely to be applied to those at the lower end of the spectrum of performance in any particular realm just because it's so much easier technologically.

**MCKIBBEN:** That represents a willful misreading of the society in which we live. If you look around the world, the idea that medicine and medical technology is applied where it's most needed is one of the grave misunderstandings of our time. If that were the case, we'd be spending billions of dollars fighting malaria and not baldness and erection problems.

**STOCK:** Take erection problems if you want to. I'm saying it is deficiencies that people will direct their energies toward because the incentives are so much higher. That's true with virtually every intervention that you can imagine. It is generally the sick and the ill and those who feel they are diminished in some way or another who are willing to accept the risk and burdens of these kinds of interventions, it's not someone who has an IQ way above average who is going to subject himself to an uncertain intervention to try to gain a few more points.

**MCKIBBEN:** Most of human growth hormone is being sold to parents of children who in fact were not going to be dwarves but were going to be just a little shorter than average.

**STOCK:** Shorter than average. It's how they would perceive it. In their terms. When you see these interventions, they do slip into the other realm toward enhancement, of course they do.

**KONDRAKE:** If you are seriously talking about some day being able to produce people who are a thousand years old—nearly immortal—then you are going to be able to produce human beings presumably who are six foot seven and have an IQ of two hundred, and, if this scene works, and you have people who are superior to others, aren't you going to have a huge caste system in this society? those who are the beneficiaries of genetic engineering and those who aren't?

**STOCK:** I would say that it is hard to see what sorts of limitations there will be in this realm. Because there are not obvious limitations does not mean that the battles that we fight today do not have to do with real issues that are not related to super enhancements. They simply are not. You say, "Well you don't care about embryonic stem cell work and someone like Francis Fukuyama, who has thought about this far more than you have, well Francis Fukuyama wants to actually prohibit embryonic stem cell work because he sees it as a gateway to cloning." So fear of cloning and fear of immortality and fear of these other possibilities leads to people that will make very, very damaging interventions in a process that is serving us very well and will sacrifice real people with real diseases and real pain.

**MCKIBBEN:** These are very unfair accusations.

**STOCK:** For Francis Fukuyama?

**MCKIBBEN:** Well, no. I'm saying that at the moment we should not do stem cell research until people have been willing to buy off on this series of things that would make it much less likely that if we move into these other realms.

**KONDRACKE:** Can't you draw a line between therapeutic cloning and germ line genetic engineering?

**MCKIBBEN:** You can. It takes work to do it and that is what we should be doing.

**STOCK:** OK, so here is the slippery slope that I think is a very dangerous one, and that is that you say that you do not want to do embryonic stem cell work until you're able to essentially erect a barrier between that and reproductive cloning. I would assert that you will never be able to erect that barrier, because these technologies are simply opposite sides of the same coin; they grow out of the new understandings that are emerging about life. So if you want to stop reproductive cloning, if you want to stop germ line engineering, you need to stop in vitro fertilization, you need to stop therapeutic stem cell work. In fact, I've talked with Leon Kass, and that is the direction that this will have to move if you're going to try and prevent these possibilities from emerging.

**MCKIBBEN:** Personally, I'd settle for a ban on germ line engineering at the moment and go from there—if everyone would sign on to that.

**KONDRACKE:** Which is appropriately banned by FDA regulation? What is the status of things?

**MCKIBBEN:** Until it's proved to be safe, it's recommended against.

**STOCK:** When you talk about germ line interventions, they're not banned, but you couldn't do them in a safe enough and reliable enough fashion that they would be feasible for human beings. If you knew how to do germ line engineering safely, there wouldn't be anything to do at present. So this is beyond our capacities at present, but I think it will not remain that way for very long. If you say, "Well, all I want to do is ban germ line engineering," you know that's certainly something that wouldn't be very damaging at present to the kinds of efforts that are being made in biomedical research. However, germ line engineering is going to emerge as a result of all of the germ line manipulations of mice and other lab animals, so if you really want to stop germ line manipulation in humans, rather than just pass a law that says it's illegal, you'd have to stop all of this other research as well. It's very, very difficult to draw these lines without injecting religion and philosophy and politics into just the basic discovery process.

**MCKIBBEN:** Injecting religion and philosophy and politics is precisely the meaning of this gathering here today; I mean if we're not going to do that then why even talk about it?

**KONDRACKE:** We are going to do this whole process according to our values.

**STOCK:** Right. What I am trying to get at is not when you talk about specific applications, that's fine. You want to ban reproductive cloning; I have no problem with that, even though I think it's a sideshow and it's not very important. The birth of the delayed identical twin is not going to bring down Western civilization when it finally is done—and it won't be done for a little while.

**KONDRACKE:** There is a question from the Web, and I don't want to ignore a question from the Web because we want to encourage them. This is a good question apropos of this: "Shouldn't the role of aging research be to extend the life span of long-lived people? In other words, would Bill McKibben oppose changes in aging intended to eliminate disease even if it also leads to lives of 115 or 120 years?"

**MCKIBBEN:** The goal of aging research that I think is legitimate is to do what some Asian researchers have called rectangularizing the curve, i.e. to move us as far as out as we can toward our 115 years of whatever it is in good health. Leonard Hayflick said the ideal would be live to 100 or so in robust health and quietly slip away. That strikes me as useful.

**KONDRACKE:** Before you answer, if anybody in the audience would like to ask a question there's a microphone right over there and we invite your participation.

**STOCK:** Two comments on that. First of all, we can talk about rectangularizing life expectancy and such—this is very abstract, this is philosophy, this is very different from when you're in the trenches and you're trying to develop an intervention for some particular disease—then you're in the forest and you only see the trees, not the forest, so you're imposing that in larger sense. That's where we differ in terms of this sort of abstract discussion of where these things might eventually lead and what the challenges would be that are associated with them.

**MCKIBBEN:** But you're just saying there's no point in having them because we should just go ahead?

**STOCK:** No, what I'm saying is there's a tendency to project our hopes and fears into the future and that when you see a person's vision of the future, it tells you an awful lot about whom that person is, about their values, and what they are afraid of. It seems to me that we really don't want to base our legislation upon such projections, because they tell us more about the person than about what the future is going to be. You're going to see that when there are concrete problems that emerge—that is the time to deal with them.

**MCKIBBEN:** I don't want to wait until we've engineered a generation of children. I'm not inventing my dark fantasy from some set of fears, I'm going to texts like yours, trying to enunciate what the future holds, and you say it holds parents who are engineering their children to be more religious. I think that that borders on the monstrous.

**STOCK:** So you've said you don't have any problems with screening of embryos?

**MCKIBBEN:** No I didn't say that. I said—

**STOCK:** As long as it is circumscribed.

**KONDRACKE:** Let's pause and take a question from the audience. Identify yourself, and thanks for coming to our second session.

**AUDIENCE MEMBER (BAILEY):** I'm Ron Bailey, the science correspondent for *Reason* magazine.

**KONDRACKE:** And a participant in our first discussion.

**BAILEY:** I'm puzzled about something that Bill McKibben seems to be worried about. You're worried about bionic children and semi-robots later into the future and there is inherent in this a notion that somehow or other randomly obtaining genes the way we currently do somehow confers freedom upon people. If that's the case, that's a lost cause because the fact is in about ten years we will know what genes we all have and it won't be a mystery. We'll know what genes give us our temperament, why they affect our

intelligence, and our possibilities, and so giving those genes to people randomly doesn't confer freedom.

**MCKIBBEN:** That's a very interesting question, and I guess the best one could say is that the society we've constructed over a millennium operates on the notion that there's enough of fate and free will in that sort of random combination of genes to allow us to be humans as we are now. Going past that to the point where we're picking them out of a catalog and assigning them to our children with agency, instead of by somewhat of chance, creates not only an extremely different relationship between generations, but also a very different self-understanding. Imagine yourself as the child who has been programmed by the parents to be happy, to have whatever set of genes are increasing her dopamine or serotonin level. She reaches an age of sixteen and finds herself in a sort of intellectual and emotional quandary. She's happy, but is she happy because she's happy? or is she happy because she's been programmed to be happy? You could say that perhaps you'll be able to program her enough so that such bad thoughts won't arise in her head, but if you did that, and to the point that you do that, you've created something very different. We're all influenced now by our parents, but part of the act of growing up is the rebellion against that, and rebellion is not possible in the same way if every cell in your body is expressing a protein that's been selected by your parents.

**STOCK:** So Bill, I don't think you quite responded to that question, and that's a very crucial point. Let's take it very concretely. If we have ten embryos, and we can screen those embryos for various dispositions—because the engineering you're thinking of is the parents' engineering the child—but really it's the implications that one's genetic constitution has for who one is. Now we will know all of this information within a short period of time. If a parent is to pick one of those ten embryos, and they do it because they think there will be a predisposition to be a little happier, or whatever, now how does that child have any less freedom than if that child happened to have been born randomly? The child will know his or her genetics, his or her particular genetic constitution. You're saying that you would like to think that that genetics somehow allows this child more free will than if somebody makes a choice, but I don't see that.

**MCKIBBEN:** I think that on a spectrum, that is not as bad as inserting whatever artificial chromosome you're going to be able to buy from Pfizer with a particular set of them, but I think that it retains many of those same difficulties. We should not be selecting our children in the same way we select our dogs because we have a small apartment and we don't want a dog that's going to run around a lot. What's OK with dogs is not how human beings should be relating to each other.

**KONDRACKE:** Are there any other questions from the audience?

**AUDIENCE MEMBER (SPROTT):** I'm Dick Sprott, executive director of the Ellison Medical Foundation, and I think with this comment I represent about half of those who do biomedical research. Greg and I differ in our point of view of what's possible and it has some considerable impact, I think, on the direction a debate like this might go. I should tell you at the very beginning, I am not convinced at all that the topics of this

debate are anywhere in our near future. I am really not convinced that aging is a disease or genetically programmed in the a that will allow us to attack it in the same way as we attack diseases. So given that premise, then I think one of the real dangers of the push in this direction in the press, and the push for specific kinds of legislation to deal with it, poses for us is that we run the danger of wasting very precious fiscal, intellectual, and political resources on a very highly unlikely goal at the cost of not pursuing research on the diseases of aging that would in fact improve the lives of virtually everybody on this planet if pursued in that way. So I'd be interested in your comments.

**STOCK:** I would not argue with that, and I would certainly say that meaningful germ line manipulation of embryos is at least a generation or two away. First of all, it would have to compete with the genetic screening technologies that are far more effective in doing the kinds of simple manipulations that could occur, and I don't think that it relates very much to the aging field at all, which is the point that I tried to make.

**SPROTT:** I don't either. I really am much more concerned about spending the intellectual capital on genetic manipulation of existing humans to modify the life span—that is gene therapy if you will—to modify aging, which I think many people do think is on our horizon.

**STOCK:** Now as to what is actually going to emerge: I've been trying to make the point that the immediate things that are being done are the kinds that you're talking about, attempts to cure diseases, attempts to enhance individual lives as opposed to these dreams people have of immortality or of greatly extending human life span. It's only a dream that they have, maybe it's possible, but if it proves that that is fairly likely or more plausible, then we'll deal with that. To me, the fault is in debating in this abstract philosophical realm, but all of the efforts to impact the future have to come in the contact of the present day research that is going on, which is very much in the realm of biomedical research.

**MCKIBBEN:** The idea that people are inventing out of whole cloth some idea that germ line engineering is...to quote you, "In light of our yearning for immortality the underlying biology of aging may well be the first germ line intervention to truly tempt us." It was you that raised the specter of it, and in fact in a conference you organized on germ line engineering it was one of the repeated themes. The point I'm trying to make is, if this is true, germ line engineering isn't necessary, then let's take it off the table and let's stop talking about the inevitable redesign of human beings and the design of babies and things. Let's take that out of the equation and content ourselves with work in a much more limited and human sphere—not talk about going post-human, not talking as you do about fast-forwarding human evolution to the point where we are no longer ourselves.

**STOCK:** When you talk about fast-forwarding human evolution, it seems evolution goes very, very slowly—things that would occur in one hundred years or two hundred years or five hundred years—that's just an instant in the evolutionary time scale. To fast-forward evolution doesn't mean you see it tomorrow. Now, if you're talking about my belief that attempts to do anti-aging research are going to be a reason that people move into germ line engineering, that does not mean that the major research in the field of anti-aging

medicine is going to be germ line for the foreseeable future. So those two things are rather different, and I think that was the point that was really being mentioned.

**MCKIBBEN:** And work that can be done without raising those kinds of problems, those kinds of possibilities, without making them any more likely, without leading us in that direction is work I think that people will—I think there will be no point in having a debate about it here.

**KONDRACKE:** We're going to have to stop and let each of you have a final two minutes.

**STOCK:** I think that we need to look at these things in a larger context, which is that all of the things we've been discussing today, in particular the most challenging ones like germ line engineering where there is a question of exactly how long it will take, or efforts to retard aging, these may bring us great difficulties, but they are on the side of life. There's no question about this. People who are envisioning these things and trying to make them happen believe that they are going to enhance human life.

I think that our dangers do not lie in this realm—the side of life—we will deal with these sorts of things. The real dangers ahead from the unraveling of human biology come from the other side, the dark side, things like the weaponization of anthrax, smallpox, or bubonic plague, all of these things that are also going to occur with absolute certainty as a result of our progress in biotechnology. I think that we tend to forget about those possibilities, and that actually the advances in biomedicine, the kinds of things that are occurring today, research that should be pushing ahead with speed and vigor, are the very developments that will ease our passage through these other challenging minefields. What we need is the development of multivalent vaccines and new ways of detecting these sorts of pathogens, new cures for these kinds of infectious diseases.

These dark agents are the things that are really going to be challenging for us, and I think that if future humans look back at our era from five hundred years in the future, they probably aren't going to see it as this horrible moment when we basically faced all these challenging possibilities and altered human biology in ways that were a disaster. Basically, they are going to look back at this moment and they are going to see it as this extraordinary moment in time when we made breakthroughs that established the basis of their lives and their vision of the future before them. And that's not just artificial intelligence and moving out into space, it is the reworking of human biology, and that is going to come gradually at first and then it's going to pick up speed. For me, it's a real privilege to be alive at this moment, when all these debates are taking place and when this is occurring. What is so extraordinary is that we are actually the architects of the changes as well as their observers. I am not ashamed of this, I am proud of it. I think it's a wonderful thing, and I think that the challenge for us is that we are also the objects of these changes, and of course, this is why Bill is so concerned.

These developments will impinge our lives, our future, our children, and our health. That is why our choices are so difficult. I think we need to be as brave as we can, and move

ahead into this future trying to minimize the negative consequences and expand upon the beneficial ones. I'd like to close with a quote from Thucydides, he had a very good comment about this, one that is quite relevant today as it was in 430 B.C. He said, "The bravest are surely those who have the clearest vision of what is before them, glory and danger alike, and yet notwithstanding, go out and meet it."

**MCKIBBEN:** Let me say for the record that I'm against the weaponization of anthrax and the bubonic plague. I think that you've diagnosed very nicely where we need to really have this out over the next few years, and that's when you say that you're on the side of life. I hope that I am as well, and the next question is, what it does it mean to be on the side of life? I think that we need to be extremely careful and not trivialize the idea that meaning is important. I said earlier on—and I don't think you really answered—this sort of naïve consumer notion that more is always better lies behind an awful lot of this. There are times when more is better: living until eighty-five without Alzheimer's disease is better than living to eighty-five with Alzheimer's disease. But that doesn't tell you anything about living until 185 in any state, and it certainly doesn't tell you anything about living to a thousand.

We are extremely lucky to be alive at the moment; our lives are in many ways filled with ease and comfort and convenience, and we should be extraordinarily careful about trading in that world for what's behind door number two—especially if we can sense that behind there, there is perhaps some kind of vacuum, not some great adventure. Life now, life lived, life really lived as a human being, is a great adventure already and it doesn't need to be twice as long or with twice as high an IQ, or whatever, for it to be real and for it to be complete in some deep sense.

**KONDRACKE:** I think that's a wonderful conclusion. Thank you so much for joining us out there on the Web, and thank you for joining us in person. If this isn't profound stuff, I don't know what is. Come back next month; we're going to be having another one of these high-level debates about the human future. Thank you so much.

End.