

Bioethics and Public Policy

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The relationship between bioethics and public policy has become a rather broad subject that asks a rather simple question; namely, which moral imperatives that arise out of the study and consideration of bioethical issues should be reflected in public policies that govern us all. Such policies are after all one of the end points of the ethical debate. The question is simple enough, but the answers are difficult because Americans live in a society where even the most thoughtful citizens do not share a moral consensus on many bioethical issues. Indeed, despite the rich, inspiring and diverse array of current thinking in moral philosophy and bioethics, we continue to lack a moral consensus on some of the most profound ethical claims that some believe ought to be more fully reflected in actual public policies. This, of course, is not surprising, since it has long been recognized that no set of abstract rules can be expected to satisfy the particular contingencies represented by the cultural traditions and uncertainties that must be accommodated in real public policies. Nevertheless, since humans are a social species, all human societies continue to seek to establish rules of conduct that govern relationships between individuals and are thought to serve their collective interests. Furthermore, this search goes on within an evolving cultural context, and these collective rules of conduct must be constantly reviewed and perhaps revised and updated.

Thus, the first lesson is that in a society such as ours there will be perpetual uncertainty regarding which of the many competing ethical concerns ought to shape particular public policies. The second lesson follows from the first; namely, we cannot escape the anxiety that characterizes a situation where the justifiability of many ethical claims remains uncertain, or at least unconvincing, to important segments of the community. Finally, in my view, the set of “optimal” ethical views -- i.e., those that will generate the most reliable and redeeming developmental outcomes -- are unlikely to remain fixed in view of our dramatically changing circumstances. Our collective interests are likely to change, for example, given our new capacity to more radically control our future gene pool. Similarly, if we should gain the ability to

transform cells at will from one form of gene expression to another, our concept of the moral status of various human biological materials may be altered. At a more macro level our collective interests and, therefore, our ethical obligations relating to the sharing of the Earth's resources may well shift as we face radically new environmental problems. Indeed, such shifts in values might well be required if the survival of the species homo sapiens is important to us.

At times the many uncertainties surrounding all of the above concerns seem both important and almost boundless. We are, for example, uncertain about the nature of the limits to impose collectively on individual autonomy. We are undecided about the merit of the claims that various notions of distributive justice imply for our public policies, either across the generations or at any given time within particular societies or across the nations. We are uncertain which bioethical principles, theories, or frameworks should have priority in the formation of public policy. We are increasingly uncertain about what it means to be human either in a biological sense or a cultural sense. In addition, there continue to be areas of moral disagreement, particularly surrounding issues of birth and death, where it remains difficult in our society to have thoughtful and mutually empathetic conversations among those with opposing views. This is unfortunate since such conversations are the normal vehicle whereby a peaceful and morally pluralistic society learns to live together. Finally, even while we strive for greater moral agreement or understanding, we at least try to resist any temptation to exert moral tyranny over others and instead place our faith in the difficult task of momentarily stepping outside of our own commitments, histories, and circumstances to help define and re-define a robust core of moral propositions that can be incorporated into the narratives of most people.

Returning to the issue of bioethics and public policy, it seems certain that many new controversial public policy issues will arise out of ongoing developments on the frontier of biomedical science and their associated bioethical considerations. Indeed, it is inevitable that the rapid pace of development of new knowledge and, therefore, new opportunities -- i.e.,

applications -- is certain to generate new issues and new anxieties in the ethical arena. We can anticipate, therefore, a continued search for those social processes or controls, possibly public policies of one type or another, that will improve our chances of selecting the most ethically acceptable applications of our ever-expanding knowledge base. As a result, just as we expect that new science will gain its moral relevance from the nature of the uses we make of new knowledge, we should understand that our moral propositions -- old and new -- are themselves about to be tested and re-tested in their application to our evolving social, cultural, and historical circumstances, and the ever-changing technological context.

CONCERNS

Although signs of immense human accomplishments are all about us, no previous century has produced such a high level of apprehension about the future. Perhaps the reason for this is that as science generates an ever-larger set of opportunities for us all, it simultaneously raises the level of moral responsibility that falls on our shoulders, and it is this moral or ethical challenge about which we are so uncertain. This nervousness, ethical malaise, anxiety, or even foreboding reflect, I believe, in addition to the fragility of traditional reference systems, a shared understanding that humankind's destiny will not be decided in full in the laboratory or at the genetic level, where we have a lot more confidence in our ability to find solutions. Whatever else we may need to address these concerns and the many new issues and opportunities rushing toward us, we need new sources of reflection to enrich the ongoing ethical debates.

Perhaps all this explains why a short time ago I was asked to address a conference with the rather "arresting" title of "Stopping Science." Although concerns regarding the transformation of our lives and our prospects by the ongoing application of new scientific discoveries have a very ancient pedigree, the stunning pace and nature of recent scientific advances, particularly in biology, have been disquieting to some. Indeed, let me quote from two different letters I received from President Clinton in my capacity as chair of the National

Bioethics Advisory Commission:

While this technological advance [somatic cell nuclear transfer cloning] could offer potential benefits . . . it also raises serious ethical concerns. . . . (February 1997)

This week's report of the creation of an embryonic stem cell that is part human and part cow raises the most serious of ethical, medical, and legal concerns. . . I am therefore requesting that the National Bioethics Advisory Commission consider the implications of such research. . . and report back to me as soon as possible. (November 1998)

In the last year and a half, therefore, the President of the United States has expressed some serious ethical concerns arising out of developments on the scientific frontier. As always, of course, it was not the scientific developments themselves that caused the concern, but their potential applications, as well as, perhaps, concerns regarding the limits (if any) of technology and the pace of discovery in the absence of a moral compass. However, in both cases there was at least some suggestion that public policy should address itself to the moral or ethical content -- i.e., application -- of scientific developments and perhaps try to arrest, or to shape in some way, farther developments in certain scientific or technological areas. I would like to reflect, therefore, on the role of ethical considerations in the formation of those public policies specifically aimed at shaping the nature of the scientific agenda.

PUBLIC POLICY, THE SCIENTIFIC AGENDA, AND ETHICS

The overall impact of public policy on the shape and scope of the scientific agenda has become so widespread that, for the most part, we scarcely take any special notice of it. The influence of public policy operates day in and day out not only through the magnitude and distribution of government support for various aspects of the scientific enterprise (including the education of scientists), but also through a broad series of laws and regulations dealing with such

diverse issues as the control of toxic substances, tax laws, the use of animals in research protocols, environmental regulations, patent policy, the design and conduct of clinical trials, and so on. In summary, public policy influences science through the problems it deems worth solving, the methods it finds acceptable, and the resources it makes available for the task. Moreover, behind some of these public policies lie ethical (and other) commitments and values that, for the most part, we scarcely bother to articulate. It is my own view that a more systematic articulation of the particular ethical commitments, if any, that help inform these existing and long-established policies would not only be salutary, but would prepare us better for the new and perhaps more complex ethical challenges that will face certain public policies in the future. It is also true that developments in science and technology and the views of the science and technology community influence public policy in general and science and technology policy in particular.

Although many of these ethical issues go unnoticed in the rush of our day-to-day concerns, we do take much greater notice of the stance of science policy when it directly concerns morally contested areas such as human cloning — i.e., the potential use of somatic cell nuclear transfer techniques to create infants — and embryo research or genetic engineering, which raise important moral concerns for some. With this in mind, I will narrow the scope of my paper to consider the special issue of how public policy concerns sometimes become focused on efforts to place negative constraints on the shape of the scientific agenda and the applications of the new knowledge. By negative constraints, I mean instructions not to do something, as opposed to positive constraints, which are designed to encourage one to proceed in a particular direction. More specifically, how did we ever become concerned, for example, with “Stopping Science”? For reasons that are not fully clear to me it is also the case that public policy in the arena of bioethics seems primarily focused on restraints, but perhaps all of ethics is in this category!

“STOPPING SCIENCE”

“Stopping” phases or expressions like “Stopping Science” have a rather special resonance to them. They seem to have a certain bracing quality that not only beckons us to purposeful action, but often contains an obvious imperative of some sort, such as “stop the violence,” and/or an understandable wish, such as “stop AIDS” or “stop cancer,” or even “stop inflation.” Indeed, we are now stopping so many things that there is a new literary genre dealing with “the end,” the End of Empire, End of History, End of God, End of Affluence, End of the Nation State, and perhaps most relevant here, the End of Science, and so on. The argument suggesting the “end of science” is stunning in its claims, but it is equally unconvincing. The claims are that all unique discoveries have already been made and that only increasingly specialized “clean up” operations remain. The argument does, however, allow for a rather endless stream of further developments in the application of the “final” corpus of scientific knowledge -- i.e., technology. Therefore, even if science is at an end, its moral content would remain an on-going challenge though the applications of the technologies that are selected.

I will focus, however, on a special sub-class of “stopping” phases; namely, those that urge us to stop, or slow down, something that most people think, on balance, is a very good thing. Here we are presented with a much more subtle matter. Like the more general class of “stopping” phases, these rather distinct rallying cries are intended, once again, to promise us a better world if only we will act, but this time the promised prize is available only if we have the wisdom to see the ultimate futility of contemporary beliefs and the dangerous, but somewhat hidden, dynamic of our present circumstances. Thus, for example, however positive developments in science and/or technology may seem, someone is suggesting that a deeper look into their full impact would generate some concerns regarding such issues as the meaning of these new developments for sustaining our capacity to live together and for comprehending the place of human societies in the grander scheme of things.

These more subtle “rallying cries,” therefore, not only call us to purposeful action, but

call us to account, in a biblical sort of way, for our intellectual shortcomings and the lethargy that together prevent us from being agents of positive change. Such phases are intriguing (even if often misleading) because they represent, on the one hand, an effort to mobilize us and, on the other, an effort to scold us for our inability to see things as they really are. It is almost as if one is calling on the blissfully ignorant to solve a complex problem! In any case, it is into this category that phases such as “Stop Science” or “Stop Progress” (whatever that means)¹ or “Stop Technology” fall, and since they dare us to think anew about some central matters in our lives our initial reactions are often, to borrow a phrase from psychology, “Flight” (refusal to face the issue) or “Fight” (refusal to accept the premises of the new idea).

The reaction of “flight or fight” is understandable in the sense that to look below the surface of things is to risk the discovery of a “new truth” and, therefore, the need to replace previous beliefs with a new set of ideas. Fortunately, contemporary observers have many intellectual resources for attending to such situations, since much of modern thought, from Darwin, Freud, Marx, and Einstein to the ideas that surround the more recent notion of the social construction of reality (to say nothing about the continuing avalanche of scientific discoveries), deals with the ‘uncovering’ of truths that replace a set of former beliefs that finally have been revealed to be badly mistaken or convenient myths.

The stopping-science crowd might suggest, for example, that our prevailing confidence in human competence, technology, and science may, in the fullness of time, turn out to be just another myth that needs to be modified or set aside! After all, the continuing popularity of the

¹ Although many believe the notion of progress to be an idea of the eighteenth-century Enlightenment, biblical/religious sources both embrace it -- e.g., the Exodus story -- and reject it -- e.g., we are mired in sin, misery, and pain. Moreover, there are contemporary observers who deny that any progress has taken place and that even the process of evolution is meandering nowhere. To others it seems unclear whether the notion of progress is an appropriate criterion with which to measure ourselves. At the cosmological level, of course, the world as we know it seems to be a result of a rather chaotic series of events with direction but no real purpose.

Faust legend suggests pretty much the same thing. Scientists should not feel too defensive about the existence of such views for at least two reasons. First, most people, as well as most policymakers, do not find this perspective compelling. Second, in addition to any concerns some might have with respect to science, there are other defining elements of twentieth-century life that cause despair in certain quarters. Many would say, for example, that there is or should be a widespread revolt against modernism in all its various forms, since its over-intellectualization of life, values, and art undermines much older and more sustaining beliefs. I leave this latter issue for another time.

Irrespective of one's views on the ultimate impact of science and technology on the evolving human condition, there seems to be a clear need for all thoughtful citizens to consider the ongoing and changing impact of science and especially of technology on those institutions, values, and other cultural commitments that sustain our individual and common lives, since it is in these areas that science and technology gain moral relevance. It is important, therefore, not just to celebrate discovery and its many benefits but to consider as well the different possible moral repercussions of new knowledge. Indeed, the more dependent we become on new science and technology, the more essential it is to generate renaissance after renaissance in moral philosophy. For example, I believe it is the explosive growth in the development of new knowledge that has generated the renaissance in interest in moral philosophy of the last two or three decades.

SCIENCE AND THE HUMAN NARRATIVE

It is critical to remind ourselves that scientific theories have nothing very interesting to say about either the value of a human being or the meaning of the nature of the lives we lead together. As John Maynard Smith (1984) has pointed out, the purpose of "myth" or other constructed and/or revealed narratives is to define our place in nature and to give us a sense of purpose and value. It is these special "myths" or narratives that give us moral guidance or

suggest how we should act. Stated another way, scientific theories say nothing about what is right in a moral sense, but only speak of what is possible. The source of our values, therefore, must come from outside science. Thus, although myths and narratives, on the one hand, and science, on the other, are both constructs of the human mind, their functions are quite different and meet different needs. In particular, deciding how we should act, including what public policies we should enact, is a negotiated social decision that necessarily involves resources outside of science such as our cumulative cultural traditions and other historical contingencies.

Thus, although crass self interest and/or unexamined fears may cause some to want to stop or redirect a branch of scientific investigation or to interfere with the existing dynamic underlying the development of a new technology, such concerns could, from time to time, also be motivated by the desire to try to understand the moral content of what is about to happen. After all, everyone could agree that what is scientifically and technically possible must be parsed into those applications that are desirable and those that are undesirable either on ethical or other grounds. As we march into our future, we should, in short, never confuse what we can do with what we should do.

We need to acknowledge that many persons with genuine respect for the continuing contributions of science and technology also have serious commitments to various ontological positions, having to do, for example, with deeply held views regarding the limits on appropriate human behavior and/or activity. Equally important, however, there are the more secular concerns about the continued capacity of human institutions and nature itself to survive both advancing science and technology and the associated desires to control and possess all. As Havelock Ellis (1923, p. 352) commented long ago in The Dance of Life: “The sun, the moon, the stars would have disappeared long ago, had they happened to be within reach of predatory human hands.”

Concerns regarding such issues are found throughout the historical record of Western

civilization and are widespread in the Western literary and cultural tradition. Indeed, uncertainty has always existed within the Western tradition about whether the relationship of humans to the natural world is one of control and exploitation or of praise, celebration, and awe. This uncertainty raises interesting questions. Does our survival as humans require a shift in our values and aspirations? Do we need new ethics to moderate our desires for dominion, acquisition, and power? Is it true that the only way we save our souls is to find some moral compass, or moral limits, to our desire to conquer and control all and to possess all? Perhaps only such limits can save us from the moral ambiguity of our own cleverness and help us realize that even we cannot transcend nature without nature.

Within the human narrative of the West, the notion that advances in science and technology are Janus-faced -- both friend and foe -- and can bring both vast good and catastrophic evil is a truly ancient one, deeply embedded, for example, in classical Greek culture, where science and technology are often characterized as bringing both promise and peril, hope and despair. Moreover, even in those early days, the focus of concern was on the implications of new knowledge for the meaning of being human and on what new and perhaps dark human desires, which might distort the human journey, would be released by the new power generated by that knowledge. Since the earliest days, therefore, the issue has been how we understand the nature of what it means to be human within the context of our new knowledge about the natural world and how these developments will influence the future of the human condition? Listen, for example, to the voices of Ovid and Sophocles, which speak directly to the issue of mankind's evolving role and whether limits to our power are an essential aspect of our humanity.

What you want, my son, is dangerous, you ask for power beyond your strength and years: your lot is mortal. But what you ask is beyond the lot of mortals. ("Story of Phaethon" in Ovid's Metamorphoses, Book II)

Many things are formidable, and none more formidable than man,... And he wears away the highest of the gods, Earth, immortal and unwearying, as his ploughs go back and forth from year to year,... Skillful beyond hope is the contrivance of his art, he advances sometimes to evil and other times to good,... May he who does such things never sit by my hearth or share my thoughts. (Sophocles' choral "Ode to Man" in Antigone)

In this same vein, the "Tower of Babel" story portrays a massive but fruitless building project and epitomizes what some believe is the folly of human technological action taken in complete autonomy from God. Likewise, one could ask today if various genetic engineering proposals, for example, are a similar act of 'hubris' as we try to alter what some believe God has wrought. Once again such questions might suggest that we should consider the natural world to be more than merely instrumental to human purposes. Elsewhere, of course -- e.g., Ecclesiastes -- the Bible warns that with new knowledge can come much grief. It goes almost without saying, however, that alternative views about science and technology also have an ancient lineage. Aspects of the Judeo-Christian ethic, for example — particularly the notion of humankind's perpetual progress within the divine unfolding of history (e.g., the Exodus story) — have been responsible for, some would say, transforming a reverence for nature to a "mere" resource to support humankind's efforts to achieve their (and God's) program of upward progress. Consider the following verses from Genesis.

God said: Let us make humankind, in our image, according to our likeness! Let them have dominion over...all the Earth.... Bear fruit and be many and fill the Earth and subdue it! (Gen. 1: 26-28)

The same verses, of course, not only have a variety of interpretations, but also provide support for the widely held Western notion of the moral superiority of human life over other forms of life.

These verses, and the countless others that have become part of the Western literary tradition, reflect that, in addition to our great enthusiasm for technological progress, often there exists just below the surface of our consciousness a certain amount of pent-up anxiety regarding the impact of science and new technology both on a wide variety of honored practices, important values, and other longstanding cultural commitments and on the inherent limits on the ability of science and technology to address important aspects of the human condition.

At some level, therefore, we have always known that the final crisis of science and technology is the realization that they cannot be relied upon to deal with some of the most important issues of our lives as individuals and our lives as members of coherent communities. Science and technology, despite their protean strengths, cannot help us decide how human beings should act or how they are to construct a coherent and secure narrative of their place in the grander scheme of things. It is not surprising, therefore, that early myths and/or narratives from almost every culture foretell the inevitable crises of knowledge; namely, that after we know all about the natural world and possess all material things, we will still find, as I have already noted, that many of our most important needs remain unaddressed.

Anyone who has actually studied the evolving condition of human societies over time cannot help but be impressed by the contribution of science and technology not only to a fuller understanding of the natural world and a fuller expression of our humanity but to the reduction of individual human suffering. Moreover, science cannot be regarded merely as a generator and storehouse of facts, but surely must be ranked as one of the great human endeavors of all time. Nevertheless, as with the Ancients, we must continue to acknowledge that while there does not seem to be anything particularly convincing about calling new scientific and technological developments dehumanizing, these developments can bring in their wake a certain understandable disquiet and perplexity to many. We need to acknowledge that these concerns,

even if ultimately proved groundless, need to be taken seriously, not simply because they reflect real worries, but because new scientific and technological developments often raise important moral and ethical issues that need to be confronted.

Whatever else one may say about science, one must allow that it can be quite subversive, since its focus on revealing the previously unseen reality of things works against the stability of current beliefs and our trust in or even reverence for certain values that may be required to sustain certain valuable human institutions. Although it may seem fine to have the “real truth” out (it certainly seems better than sustained ignorance!), our social institutions also rely on trust - as opposed to an unbridled skepticism -- and, as I have already noted, even a reverence for a particular set of beliefs or cultural arrangements. In addition, we have to wonder if there is anything outside of ourselves and our efforts that is worthy of reverence and awe.

IN OUR OWN TIME

In our own time, of course, we must both celebrate and contend with the fact that science and technology are advancing at an unprecedentedly rapid pace. To the extent, therefore, that science sometimes works to undermine (often quite justifiably) our faith in existing arrangements for our individual and common life, these rapid advances also generate a somewhat elevated level of concern regarding the full meaning of this new knowledge for our existing cultural commitments. Hence, it should not surprise us that, in our own time, we are simultaneously concerned with “stopping science” and fully celebrating the new scientific discoveries that arrive daily.

Consider, for example, the case of genetic engineering. On the one hand, an early type of genetic engineering was the foundation of one of humankind’s greatest achievements, namely, the successful domestication of certain plants and animals. On the other hand, these ancient processes of selective breeding were imprecise and unpredictable, and successful results took a

very long time to evolve. In contrast, however, contemporary genetic engineering -- i.e., the capacity to manipulate genes or to isolate and transfer genes both within and across species -- has become the center of both stunning scientific advances and a good deal of ethical controversy.

It is easy to understand both the excitement and the consternation generated by our new capacities in this arena. This new technology could play a decisive role in helping to meet the nutritional requirements of the world's rapidly growing population, in assisting efforts to sustain the health of our environment, and in making a wide spectrum of clinically useful medical discoveries. But there are those, perhaps a small minority, who have deep concerns about the ethical and social implications of all these potential developments. Some worry that we are proceeding at too fast a pace along a path whose implications for our sense of what it means to be human are unclear and may be overwhelming. A favorite example is that we might, because of our quite unprecedented ability to choose for and against certain types of people as our descendants, be tempted to take some dark and foreboding journey into eugenics territory. Thus, there is both great enthusiasm and some uneasiness about contemporary advances in genetics.

THE CHALLENGE AHEAD

It is easy for many of us to dismiss the uneasiness with scientific and technological developments as the mark of Luddites and others who are always upset by change and always getting in the way of progress. It would probably serve us all better, however, to separate the unjustified and unexamined feats of critics from other of their concerns, which may have some useful warnings for us all, especially in those areas of our lives that still lie beyond the reach of science itself. At the very least, we have to concede that new knowledge does not ensure that our moral wisdom and/or our public policies will rise to the occasion.

Humans have always practiced technology by adapting the natural world to serve their own ends. Indeed, such momentous developments as the domestication of plants and animals

enabled human societies to turn some of their energies to the creation of the great cultural artifacts that both define civilization and enable humans to realize more fully their potential. Nevertheless, as new technology was developed and incorporated into human societies, it has always remolded our societies in some way. At times these changes are rather minor. Often they enhance and enrich our human potential. At other times, however, the changes challenge our assumptions about life, our self-understanding, and our ways of relating to one another and the rest of the natural world, and these types of challenges continue to need our thoughtful attention.

One of the great responsibilities facing us in the twenty-first century, therefore, is to consider the social and human repercussions of our rapidly accumulating new knowledge and the appropriate stance of public policies with respect to these matters. For scientists, ethical reflection must become an integral part of the scientific agenda. This obligation is especially acute given our enhanced capacity to transform the lives of all manner of plants and animals, including ourselves. Perhaps it is not enough to use these powers to benefit humanity directly by relieving human suffering; in addition, we might wish to understand the resulting impact of these developments on the social and cultural institutions that are critical to supporting our individual and collective lives.

For many, the impact of these developments has been so startling and perplexing that some observers believe that a considerable level of hostility to developments in science and technology has developed. To some extent this hostility is sustained by the general lack of serious conversations between scientists and other thoughtful citizens. It may be, as one humorist noted, that modern science is practiced by those who lack a flair for conversation. This has not been my experience, but serious conversations between scientists and other thoughtful citizens are becoming more and more essential. By serious conversations, I refer to dialogues between individuals where the persons involved expect, though the reflective and thoughtful

engagement with the work and ideas of others, to expand their imaginations, enlarge their awareness, deepen their understanding, and hone their ability to perceive new possibilities of all kinds. Both the dividends and the risks of such conversations are their ability to transform one in important ways. These conversations are not, therefore, for individuals who think they have nothing more to learn or who are frightened by new ideas and new opportunities. All such conversations, if their potential for personal growth is to be realized, will demand both an openness to new ideas and a focused effort from all who participate. Once again, to participate in such conversations one must risk that one's own ideas might not be accepted by others and/or that their ideas might be upsetting. Such exchanges, however, can build new worlds of meaning and lasting connections of all kinds. They can lead all participants to a deeper understanding of themselves and the human narrative of which they are a part, as well as provide an enhanced capacity to help all of us meet the challenges that lie before us.

The practical issue is not whether one set of concerns and attitudes should prevail over an alternative set, but how various strategies for prioritizing or addressing human needs and desires can have a deeper and healthier interaction with each other in the public marketplace of ideas, in public policy discussions, and within evolving cultural arrangements. Within such a discourse, scientists and others should understand that one of the great unresolved challenges of the scientific revolution is our ongoing failure to adequately consider its implications in moral terms. We may or may not need new moral philosophies, but we are more likely to get to the moral high ground if scientists and others work together to help shape the uses of new knowledge. The fact that the moral context of scientific discoveries is defined by the objectives and applications of this new knowledge gives all of us additional responsibilities and inevitably new anxieties.

Unfortunately, scientists, much more frequently than others, show considerable disdain for what I would call "preventive ethics programs," which are based on the perfectly rational and

morally defensible principle of moral prudence. This principle simply recommends a certain caution in order to avoid leaving difficult questions to the lottery of future circumstances. After all, we should recall the story of Ulysses, who in an action of considerable moral strength strapped himself to the mast of his ship in order to avoid a decision he would later regret!

My own view is that the human condition will continue to be well served by sustaining the vitality of our scientific enterprises. The continuing health and robustness of the scientific and technological enterprise itself, however, depend, in part, on sustaining the intellectual authority of the scientific community, and this requires both a willingness of scientists to work with others in order to take appropriate action as new scientific understandings emerge and a continued commitment for society to sustain its belief in and incentives for the development of new and challenging ideas. This is a social and political as well as a scientific process, and social or political decisions cannot be left to scientists alone. Scientists and other thoughtful citizens must work together not only to distinguish between self-interest and community interest, sentimentality and careful thought, learning and imagination, but also to understand the power and limitations of knowledge. We all must face the fact that one of our greatest responsibilities is to consider the full implications of our new knowledge not only for relieving human suffering and distress but for the social and cultural institutions that are as critical as DNA to supporting our individual and collective lives and informing the process of evolution through natural selection.

Concern for our social and cultural institutions is a critical matter, not simply because I have some considerable affection for many of our cultural traditions, but because I believe it is impossible to maintain the sharp distinction we have gotten used to between our biological evolution as a species and our cultural evolution as families and communities. Although I am a firm believer in the theory of evolution under natural selection, I believe, as Griffith and Grey (1994) and Oyama (1985) have articulated, that reliable developmental outcomes occur because

of a wide variety of reliable interactions between developing organisms and their total environment, where the latter is composed of organisms, genes, and cytoplasm (along with a certain randomness and contingency), on the one hand, and quite different factors such as language, traditions, and even such prosaic matters as libraries, courts, universities, gravity and sunshine (again with some random and contingent factors), on the other. It seems clear to me, for example, that the plasticity of the brain's complex network makes it quite accessible to a wide variety of social and cultural stimuli. Thus, there seems to be scant basis for privileging the gene over, for example, other developmental resources, both physical and cultural, that make a critical contribution to the reliable developmental outcomes that are the observed product of the evolutionary process.

A gene, after all, cannot even replicate itself without the help, for example, of ribosomes and proteins. It turns out that only much more complicated living systems are self-replicating. It is not clear to me whether prayers — a cultural resource — or F-18s — a technological resource—will be the most decisive element in the outcome of some future battle. Moreover, as Bateson (1978) observed a generation ago, if we say a bird's nest — a cultural resource for birds — is a gene's way of making another gene, we could just as easily remark that a gene is a bird nest's way of making another bird's nest. It is more critical than ever that we expand our moral imagination beyond the thrall of the truly stunning developments in contemporary biology and enlarge our horizons regarding our understanding of what resources of all kinds — scientific, cultural, ethical, and environmental — are required to continue to be human. In short, our lives are even more complicated than we thought, and it is only by integrating the special chemistries of our biological and cultural selves that we prove the following verse entitled “The Choice” by Yeats (1933) to be quite wrong:

The intellect of man is forced to choose
Perfection of the life, or of the work,

And if it take the second must refuse
A heavenly mansion, raging in the dark.
When all the story's finished, what's the news?
In luck or out the toil has left its mark:
That old perplexity an empty purse,
Or the day's vanity, the night's remorse.

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