



Visions of Perfectibility

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Acknowledgement:

This paper was originally presented as a talk at a conference entitled "Posthuman Futures" held in Oxford by the Ian Ramsey Centre in the Faculty of Theology. The subject of the conference was what it means to be human as we contemplate a posthuman future.

Introduction

In July 2004 designer babies were again in the news. The UK's Human Embryo and Fertilisation Authority had to decide whether it could allow the practice of pre-implantation screening when the object of the tissue-typing and selection would be to give parents the chance of producing a child that might save an ailing sibling. At the same time an issue of *Science & Theology News* carried a feature on the use of such techniques at the Reproductive Genetics Institute in Chicago.¹ In several cases stem cells from the umbilical cord of one infant have been donated to the endangered brother or sister. The technology is clearly new; but it is often justified with an appeal to continuity. In the past parents have conceived a child in the hope that it will have the necessary genetic complexion to act as a saviour. The new technique simply eliminates, or promises to eliminate, the chanciness of the process. Not surprisingly, however, it raises the spectre of a positive eugenics in which parents may choose the characteristics of their offspring. Is a brave new world of human perfectibility just around the corner?

For most of us, this and related questions have become familiar. They featured in Francis Fukuyama's controversial book *Our Posthuman Future* (2002). Whatever we may think about the cogency of his arguments, Fukuyama did offer an imaginative assessment of the social consequences of transformative technologies. Explaining why we should be worried, he observed that

People want smarter kids so that they will get into Harvard, for example, but competition for places at Harvard is zero-sum: if my kid becomes smarter because of gene therapy and gets in, he or she simply displaces your kid. My decision to have a designer baby imposes a cost on you (or rather, your child), and in the aggregate it is not clear that anyone is better off. This kind of genetics arms race will impose special burdens on people who for religious or other reasons do not want their children genetically altered; if everyone

around them is doing it, it will be much harder to abstain, for fear of holding their own children back.²

We should note that reference to “religious or other reasons”. In Fukuyama’s account it is the religious objections that are said to be most transparent. With both the Catholic Church and conservative Protestants in mind, he notes that

These reproductive technologies, even if freely embraced by parents out of love for their children, are wrong from this perspective because they put human beings in the place of God in creating human life (or destroying it, in the case of abortion). ...Genetic engineering, moreover, sees a human being not as a miraculous act of divine creation, but rather as the sum of a series of material causes that can be understood and manipulated by human beings. All of this fails to respect human dignity, and thus violates God’s will.³

We might want to make finer distinctions, but even sophisticated Christian commentators have been willing to use the ‘playing God’ objection as a way of articulating a cautionary principle.

From Fukuyama, and from much of the press coverage of genetic enhancement, it would be easy to suppose that a history of technology would include a story of religious objection to innovations promising improvement, whether of nature in general or of human beings in particular. Have not our visions of perfectibility been largely secular visions? Have not our religious values been lodged in the defence of a pristine nature or of a human nature with which we interfere at our peril?

In this brief essay, I want to suggest that the story is not so simple. The relationship between the sacred and the secular in the history of technology is more complex but also more exciting than the familiar dichotomies assume. I shall therefore argue that secular ideals have often been a legacy from earlier sacred visions, though in secular cultures this often passes unnoticed. Secondly I shall point to a few homologies between sacred and secular systems of belief. Fukuyama himself insisted that Religion often intuits moral truths that are shared by non-religious people, who fail to understand that their own secular views on ethical issues are as much a matter of faith as those of religious believers. Many hardheaded natural scientists, for example, have a rational materialist understanding of the world, and yet in their political and ethical views are firmly committed to a version of liberal equality that is not all that different from the Christian view of the universal dignity of humankind.⁴

Varieties of perfectibility

I have chosen ‘visions of perfectibility’ as my title because it hints at an important truth - that dreams of a better world and of human perfectibility have been the property of both religious and secular traditions. There is of course an immediate objection to their conflation. When Christian mystics and theologians have spoken of human perfectibility, their vision has been one of spiritual growth, a progressive sanctification having as one of its pre-requisites the renunciation of the material goods and sensual pleasures of this probationary world. It is doubtful that Teresa of Avila would have bought into genetic enhancement as a way of achieving perfection. To be perfect was to be wholly given to God – an ideal Teresa was alarmed to discover she had not attained, when she recognised that she loved her sister above other women.⁵ For St John of the Cross the *imperfections* from which it was necessary to be released were any attachment to “a person, a garment, a book, a cell, a particular kind of food, [and] tittle-tattle”.⁶ Yet not all visions of perfectibility within the Christian tradition have been so austere. For John Henry

Newman, the perfect man was he who "does the work of the day perfectly". As for his prescription:

Do not lie in bed beyond the due time of rising; give your first thoughts to God; make a good visit to the Blessed Sacrament; say the Angelus devoutly; eat and drink to God's glory; say the Rosary well; keep out bad thoughts; make your evening meditation well; examine yourself daily; go to bed in good time, and you are already perfect.⁷

This was Newman speaking, as John Passmore observed, rather like a governess!

In what follows I do not wish to suggest that sacred and secular visions can or should be conflated. But if I am to do my 'work of the day' perfectly I must fulfil my promise to explore the subtle ways in which secular and sacred visions have often been related.

Utopias as derivatives of millenarian visions

One of England's early enthusiasts for the promise of technology was the seventeenth-century Protestant reformer Samuel Hartlib. Let's hear him on human longevity, a subject of perennial concern to physicians and religious thinkers:

I would have you understand my prognostication of the true universal medicine, which shall serve not only men, but also all flesh; namely, that there grows in Paradise a tree, which is, and is called the tree of Life, which in the glorious and long expected coming of Jesus Christ our God and Saviour shall be made manifest, and then it shall be afforded to men, and the fruits of it shall be gathered, by which all men and all flesh shall be delivered from death, and that as truly, solidly, and surely, as at the time of the fall, by gathering the fruit of the forbidden tree, we together with all flesh fell into sin, death and ill. And this glory and great joy hath God reserved for us, that live in these latter days, and hath kept his good wine until now... I do foretell all physicians, that then their physick shall be worth nothing; for another garden will be found, whence shall be had herbs, that shall preserve men not only from sickness, but from death itself.⁸

Note the intertwining themes: this is a vision in which there is explicit reference to the transcendent. There is *another* garden; with the coming of Christ there will be *another* dispensation; present medical effort will be trumped. But the vision of what it will be like when Christ has returned, when the earth has been restored, when there are prospects for immortality – this vision is one that could so easily be secularised to sponsor utopian speculation.⁹ In the religious vision there is assurance that the new garden will be found, that deliverance from death will be achieved solidly and surely. From fall to final redemption there is a direction to history guaranteed by a divine providence.

Nietzsche would later say that belief in the *inevitability* of progress could be seen as a thinly disguised religious way of thought and there is some justification for that view. Progress and providence were linked in the minds of seventeenth-century English Protestants, most famously by Francis Bacon. There was a sense in which one had the duty to prepare the world for Christ's return. The application of science to the relief of man's estate was one way of doing so. Bacon had no doubt that correct empirical methods would lead to a continually progressive science – superior to that of Aristotle, which had been sterile as far as practical applications were concerned. It was precisely an applied science that would help to restore human dominion over

nature, lost as a consequence of Adam's fall. The homology between sacred and secular visions was perfectly explicit in Bacon himself:

The rule of religion that a man should justify his faith by works applies also in natural philosophy; knowledge should be proved by its works. For truth is rather revealed and established by the evidence of works rather than by disputation, or even sense. Hence the human intellect and social conditions are enriched by one and the same means.¹⁰

For Bacon the linkage between providence and progress was assured by Scripture itself. Prophecies in the book of Daniel made reference to a time when many would pass to and fro and knowledge would increase. Bacon could point to the voyages of discovery, the expansion of trade and progress in natural philosophy to underscore the biblical prophecy.

In the Protestant dissenting movements of the eighteenth century, concepts of providence and progress continued to be intertwined. Joseph Priestley would write that advances in science and technology were the "means, under God, of putting an end to all undue and usurped authority in the business of religion as well as of natural philosophy".¹¹ The chemist was a collaborator with God in creating a brighter future when the world would be rid of superstition. Scientific progress provided both model and vehicle for social progress. One facet of that progress for Priestley had to be an increase in religious toleration, which in turn was a precondition of a fair competition between different religious traditions, ensuring that the most rational would eventually prevail.

Medicine as a form of redemption

In the case of Baconian science the homology between sacred and secular turned on the concept of restoration. Bacon did not make the mistake of saying that spiritual redemption could come from the applications of science, but he did envisage a time when the fruits of science would go a long way towards restoring a fallen earth. In the most famous of sixteenth and seventeenth-century medical reforms, the homology turned on concepts of purification and redemption. Among disciples of Paracelsus, an act of purification was involved in the very process of extracting remedies from their impure sources. This gave to chemistry a high profile in extracting and distilling the efficacious components of natural substances. This analogy between material and spiritual purification has been well captured by Charles Webster:

Natural products were ordained by God for man's use, but their properties would not be revealed directly, since Adam's transgression had sacrificed our rights to direct experience of nature's purity. Medicines were 'imprisoned', and they could only be isolated by the 'artificial anatomy of chemists'; their labour would show that God had created an inexhaustible supply of specific remedies, each country furnishing sufficient for its own requirements.¹²

The optimism of modern pharmacology was presaged in the Paracelsian doctrine that there were chemical remedies for all ailments – in the denial of which the Galenic physicians had a vested interest. Paracelsus attacked their indolence and the rationalisations they gave for their failure to cure. God in his mercy had provided a remedy for everything, but men had to labour hard to discover them and to extract their effective ingredients. It is also to the Paracelsians we owe the modern notion of specific causes for specific diseases and the consequent need for specific remedies.

It is worth noting that, according to some Christian commentators, humankind had originally been naturally immortal. For example Roger Bacon had observed that, even after the fall, men had retained a residual capacity to live for 1,000 years. The vision of modern medicine by comparison may look a little pale!

The body as a machine

It has often been said that modern medicine regards the body as a piece of machinery to be serviced when it goes wrong. Today we are familiar with more holistic approaches but there is no doubt that the mechanistic models have been paramount in western cultural traditions. Mechanism is often linked in peoples' minds with materialism, but it does not have to be. The most mechanistic form of physiology in seventeenth-century Europe was that of Descartes, who argued for the immortality of the soul. Of greater interest, perhaps, mechanical analogues for anatomical structures were supportive rather than destructive of religious understandings. Having examined the workings of the human eye, Isaac Newton concluded that it could only have been designed by a Mind acquainted with the laws of optics. William Paley was arguing for the same conclusion 100 years later. There were homologies between secular and sacred understandings of the body because mechanical analogues reinforced concepts of design. A machine is not the kind of thing that makes itself. Or so it was naturally assumed until more sophisticated models of organic change materialised in the nineteenth century.

This particular convergence of sacred and secular understandings of nature was deeply entrenched in the culture of science popularisation until the Darwinian era and beyond. In the seventeenth century it had been common to compare the universe to the great cathedral clock in Strasbourg. One could study its workings without prejudice to the claim that it had been designed for a purpose. And such were the fantastic designs revealed through the microscope that Robert Boyle would conclude that only those who had not studied nature could be atheists. Mechanical images of nature always ran the risk of reductionism; but they definitely served ulterior theological as well as medical interests.

If nature ran like machinery one could dispense with a host of spirit agencies in nature that compromised, or were perceived to compromise, the sovereignty of God. There is some truth in the assertion, made by the Dutch historian of science Reijer Hooykaas among others, that one of the preconditions of modern science was this "de-deification" of nature.¹³ It is true, of course, that Darwin's *Origin of Species* (1859) became the focus (and still is) for arguments purporting to expel teleology from the world. But, at a deeper level, we find that another interesting homology was preserved rather than destroyed.

Perfectible adaptation

We must all be familiar with the way in which Darwin's theory undermined the design argument as Paley formulated it. Natural selection, operating over countless generations, could counterfeit design. The antithesis between a sacred and a secular reading of nature is epitomised by Richard Dawkins' treatment in *The Blind Watchmaker* (1986). The issues are, however, too subtle to capture in a simple antithesis. When Darwin composed his *Descent of Man* (1871) he did not set out to subvert Christian values, even though by then he had largely lost his early faith. He did not argue for the relativity of ethical values. His object rather was to explain, naturalistically, how the highest ethical norms had come to be as they are. He explained how the golden rule that we should treat others as we would wish them to treat us had developed. He did not suggest it was dispensable. Indeed his hostile attitude to slavery has been seen by his biographer, James Moore, as a survival of the Christian faith he had lost. In fact several historians have noted that even the most

radical of the scientific naturalists tended to naturalise values that had been prominent in the religious traditions they were calling into question.

Nor is it entirely true that Darwin evacuated Paley's argument, since Paley had focussed not only on the exquisite design of organic structures, but also on the general laws of nature that the physical scientists had discovered. The argument from the very existence of laws of nature to a divine legislator was barely touched by Darwinian theory. Darwin himself had spoken of a Creator creating through laws – laws, to use his own language again, impressed upon matter by the Creator.¹⁴ It is true that this kind of language would sit comfortably with deistic models of nature; but the metaphysics with which it was often associated was one in which sacred and secular understandings could be almost perfectly fused.

Additionally, there is a homology between Darwinian natural selection and Paley's natural theology that was recognised by Darwin himself. Both natural selection and natural theology broadly require that an organic structure be useful to the survival of the organism. The adaptation did not have to be perfect, though under the influence of Paley it is possible that Darwin for some time believed it be so. Evolution was perhaps nature's way of preserving perfect adaptation in changing environments. The legacy of Paley's thinking may have constrained Darwin; but the analogy between sacred and secular visions he made absolutely clear:

I was not ... able to annul the influence of my former belief, then almost universal, that each species had been purposely created; and this led to my tacit assumption that every detail of structure, excepting rudiments, was of some special, though unrecognised service. Any one with this assumption in his mind would naturally extend too far the action of natural selection.¹⁵

I have entered these Darwinian waters because there is an argument for deference towards an existing state of nature that can come from evolutionary biology itself. If, in Darwin's words, natural selection works for the improvement of every organism, might there not be arguments against undue genetic interference, grounded in the degree of perfection natural selection itself achieves? Fukuyama may have exaggerated the import of this particular consideration but his concerns have to be addressed:

There are good prudential reasons to defer to the natural order of things and not to think that human beings can easily improve on it through casual intervention. This has proven true with regard to the environment: ecosystems are interconnected wholes whose complexity we frequently don't understand; building a dam or introducing a plant monoculture into an area disrupts unseen relationships and destroys the system's balance in totally unanticipated ways. So too with human nature. There are many aspects of human nature that we think we understand all too well or would want to change if we had the opportunity. But doing nature one better isn't always that easy; evolution may be blind process, but it follows a ruthless adaptive logic that makes organisms fit for their environments.¹⁶

The Scientist as Co-Creator

Those who write about the relations between science & religion or between theology and technology have sometimes made the mistake of thinking in essentialist terms – as if there might be a definitive relationship between a religious doctrine and an attitude towards an undifferentiated entity called 'science' or 'technology'. The problem is not only that the meaning and content of 'science' have change with time, but also that everything depends on how the doctrine in question is interpreted. For example, in some formulations the doctrine of creation could be conducive to

the physical sciences – as it was for Copernicus, Kepler and Newton, each of whom celebrated the greater elegance and harmony that could be achieved by placing the sun rather than the earth at the centre (or focus) of a planetary system. A voluntarist theology of creation also lent itself to the defence of empirical methodologies because the more one stressed God's freedom to make any universe God wished, the more necessary it was to investigate empirically which of the many possibilities had in fact been instantiated. But we also know that creation doctrine could be *obstructive* to certain forms of science if formulated in other ways. If the doctrine itself were taken to imply an essentialism, that the species God had created were immutable because each reproduced after its kind, then concepts of the mutability of species would encounter resistance – as we know they did for much of the nineteenth century.

This dependency on how religious doctrine is interpreted becomes especially crucial when considering the premise that humans have a unique dignity because of their having been made in the image of God. This premise often features in discussions of biotechnology, but on the side of the objections. It does so in Fukuyama's discussion. And it has often been made to stand in the way of anything that threatens that special dignity - such as using a person as an instrument, especially if exclusively a means to an end. This clearly can be an issue in discussions ofaviour siblings. But there is the other side of the coin. Perhaps one of things it might mean to be made in the image of God is that we may, in some respects, have the prerogative to imitate God, or in more modest language, operate as collaborators with God-given resources. Using the suggestive language of Philip Hefner, why should we not see ourselves as created co-creators?

In one sense this description is suspect because the most human creators can do is to act like a Platonist demiurge using the materials we already have at our disposal. The basic question, however, remains: could not responsible, therapeutic genetic engineering be seen to be in line with our responsibility, as Francis Bacon saw it, to offer glory to God and to seek the relief of man's estate? Creation doctrine is involved here, because as Newton pointed out:

If any think it possible that God may produce some intellectual creature so perfect that he could, by divine accord, in turn produce creatures of a lower order, this so far from detracting from the divine power enhances it; for that power which can bring forth creatures not only directly but through the mediation of other creatures is exceedingly, not to say infinitely greater.¹⁷

This same logic was applied by Christian theologians in the wake of the Darwinian controversies, both Charles Kingsley and Frederick Temple celebrating a deity who evinced a greater wisdom than before, not merely in making things but in making things make themselves. There is a danger here of being too facile. From where do we derive the ethical principles to ensure that the work of the biotechnologist could also be deemed to be God's work? But that does not mean we should ignore this more liberal resonance within theological tradition. Where the manipulation of nature is seen as a form of collaboration with God-given resources, the space has been created, at least in principle, for pursuing schemes of perfectibility.

Looking at this way, yet another analogy appears between the sacred and the secular - symbolized by the sympathy between two writers on human perfectibility who at first glance might be thought to have nothing in common: the Jesuit visionary Teilhard de Chardin and the secular prophet of evolutionary humanism, Julian Huxley. Both wrote extensively on the uniqueness of man and the value of the individual life. Here is Huxley drawing the parallel I have in mind:

A ... major concept is the primacy of the human individual, or, to use a better term, the primacy of personality. This primacy of human personality has been, in different ways, a *postulate* both of Christianity and of liberal democracy: but it is a *fact* of evolution. By whatever objective standard we choose to take, properly developed human personalities are the highest products of evolution; they have greater capacities and have reached a higher level of organization than any other parts of the world substance.¹⁸

Of his own philosophy, Huxley said that he found himself "inevitably drawn to use the language of religion".¹⁹ When he goes on to say that he is envisaging the germ of a new religion that need not necessarily supplant existing religions, we can perhaps understand why he was willing to listen to Teilhard de Chardin in a way that Peter Medawar famously was not.

Teilhard's vision of human perfectibility was profoundly eclectic. It was brilliantly summarized by John Passmore in his book *The Perfectibility of Man*:

To an extraordinary degree ... Teilhard, built into a single system almost all the main forms of perfectibilism which we have so far distinguished from one another. He was a mystic: perfection consists in union with God. He was a Christian: perfection depends on Christ's working in man through evolution. He was a metaphysician: perfection consists in the development to its final form of that consciousness which is present, according to Teilhard, even in elementary electrons. He believed in perfection through science: scientific research is, in his eyes, the prototype of "working with God". He believed in perfection through social change: men are to be perfected through their participation in a society infused with love. He believed that Christianity shows us in what perfection consists...He was Pelagian in his constant emphasis on human effort; he was anti-Pelagian in so far as he argued that God's grace is essential if mankind is to achieve its final perfection.²⁰

Passmore goes on to say that, if Teilhard had not existed, it would almost have been necessary to invent him in order to weave together the different metaphysical threads with which visions of perfectibility have been associated. It is not my purpose to praise Teilhard – rather to show that in the very possibility of the synthesis that Passmore describes, there is evidence of a congruence between sacred and secular motifs.

Sibling saviours

For my last example of such congruence I turn to the problem with which I began, the case of saviour siblings, or, for reasons that should become clear, the case of what might prefer to call sibling saviours. The vocabulary of perfectibility may be inappropriate here, since we are talking about remedial techniques; but those same techniques obviously could be used for more ambitious engineering. Others have thought about this problem more deeply than I, but I have thought enough to see how difficult it can be to weigh the respective arguments. The issues are complex because if the additional child were to be perceived by the parents as *only* a means to an end, then references to impropriety might be salient. However, one could envisage that the saving child would be loved all the more for having made a priceless contribution to the life of the family. It is even conceivable that parents with religious convictions would see in the technological intervention a kind of "miracle" that would not preclude seeing the later child as a divine gift. From the child's point of view, it is surely undeniable that there could be deeply conflicting feelings. It might be difficult to prevent the feeling that they would not have come into being had they not been wanted for the saviour role – especially if they were to suspect that their

parents would not otherwise have had another child. An additional concern might be the guilt feelings that could come from the knowledge that, in the selection process, other embryos had been discarded. There could be the loss of that uninhibited gratitude for life, springing from the sheer improbability of one's existence, on which both religious and secular writers have movingly written.²¹

On the other hand, the child might grow up to be grateful for the fact that its life had been given an additional meaning by virtue of its saving role – and even a possible religious meaning in conforming to a model of redemption through sacrifice. One thing is certain. It is impossible to generalise about consequences. What in one family might be a binding process, in another could be explosive. In the real world of sibling rivalry and jealousy, it is discomfiting to contemplate a scene in which one child could say to another, “but for the grace of *me* you would be dead” or “if it hadn't been for my illness you would never have been born”. Speculations about psychological damage cannot be excluded from the debate and it should not be surprising that religious commentators take them seriously. Indeed, John Polkinghorne once declared the production of “saviour siblings” unacceptable: “it would be very psychologically damaging for a child even to suspect that he or she owed their existence primarily to the duty to help a sibling, rather than for the sake of the value and worth of their own being”.²²

The very fact, however, that it is possible to speak of religious meanings in the birth and saving role of a sibling, suggests to me the possibility of this additional homology in the current debate. After all, it is open to the medical ethicist to argue that of all the reasons people may own for having babies, this is a “wonderful” one, since most are born of either mindless sex or out of selfish considerations.²³

Conclusion

I have been suggesting that, despite the prevalent and understandable impression of religious votes being lined up against new technologies, a deeper and longer term perspective suggests that we must also do justice to traditions of thought in which the secular and the sacred have a surprisingly large amount in common. I am not of course arguing for a conflation. In a perceptive essay on science and secularisation, the theologian Janet Martin Soskice has contrasted two kinds of hope, two kinds of vision. In secular visions of perfectibility, a time is envisaged when it would be marvellous for those lucky enough to be alive at that time; but in this vision little solace is offered to those whose lives have been a means to this glorious end. By contrast, “Christian hope looks forward to God's time, the kingdom, when all will be well and when every tear will be dried, when all the suffering of the world through its ragged and jagged history will be made whole”.²⁴ That first kind of vision was perfectly articulated by Benjamin Franklin when he lamented the fact that he might not have been born in an optimal era. In a letter to Joseph Priestley he wrote:

The rapid progress the sciences now make occasions my regrets sometimes that I was born too soon. It is impossible to imagine the heights to which may be carried in a thousand years the power of man over matter...All diseases may by sure means be prevented or cured, not excepting even that of old age, and our lives lengthened at pleasure, even beyond the antediluvian standard.²⁵

Whether a Christian understanding of hope would strictly allow such regrets is a nice question. Such contrasts, notwithstanding, I have aimed to bring out some of the congruence between the sacred and the secular and for at least two reasons. First it helps us to understand the depth of the controversies when they occur, because in this, as in so many disputes, the greatest tensions can exist between positions that are

very close rather than very distant. Secondly it helps us to understand something of the complexity in the relations between science and secularity. The simple model of religions in retreat as scientific rationalism advances is not at all satisfactory. As the anthropologist Mary Douglas insisted long ago, it is a model that only works by ignoring the fact that religious beliefs are more about the quality of social relations than the state of scientific knowledge. It is a model that also ignores the fact that scientific knowledge can itself give rise to feelings of awe and ultimate mystery. On the point that the sciences do not entail secularism I find myself in agreement with Fukuyama. He, however, goes further and makes a proposal that would require another essay, or many, for its evaluation:

The view that religion will necessarily give ground to scientific rationalism with the progress of education and modernization more generally is itself extraordinarily naive and detached from empirical reality...The ability of modern societies to free themselves of authoritative accounts of who they are and where they are going is much more difficult than many scientists assume. Nor is it clear that these societies would necessarily be better off without such accounts.

And he continues : " Given the fact that people with strong religious views are not likely to disappear from the political scene anytime soon in modern democracies, it behoves nonreligious people to accept the dictates of democratic pluralism and show greater tolerance for religious views" .²⁶

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- ¹ *Science and Theology News*, July/August 2004, 10.
- ² Francis Fukuyama, *Our Posthuman Future: Consequences of the Biotechnology Revolution* (London: Profile Books, 2002), 97.
- ³ *Ibid.*, 89.
- ⁴ *Ibid.*, 90.
- ⁵ John Passmore, *The Perfectibility of Man* (London: Duckworth, 1970), 120.
- ⁶ *Ibid.*, 128.
- ⁷ *Ibid.*, 123.
- ⁸ Samuel Hartlib, Appendix to his *Chymical Essays* (1655), cited by Charles Webster, *The Great Instauration: Science, Medicine and Reform 1626-1660* (London: Duckworth, 1975), 246.
- ⁹ Ernst Tuveson, *Millennium and Utopia* (New York: Harper, 1964).
- ¹⁰ Francis Bacon, *Novum Organum*, book II, aphorism 52, cited by Webster, *The Great Instauration*, 325.
- ¹¹ John H. Brooke, " 'A sower went forth': Joseph Priestley and the ministry of reform", in *Motion Toward Perfection: The Achievement of Joseph Priestley*, ed. A. T Schwartz and J. G. McEvoy (Boston: Skinner House, 1990), 21-56.
- ¹² Webster, *The Great Instauration*, 284.
- ¹³ Reijer Hooykaas, *Religion and the Rise of Modern Science* (Edinburgh: Scottish Academic Press, 1972).
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- ¹⁵ Charles Darwin, *The Descent of Man*, 2nd ed. (London: Murray, 1906), 92.
- ¹⁶ Fukuyama, *Our Posthuman Future*, 97-8.
- ¹⁷ Cited by Betty Jo Dobbs, *The Janus Faces of Genius* (Cambridge: Cambridge University Press, 1991), 36.
- ¹⁸ Julian Huxley, *Evolution in Action* (Harmondsworth: Pelican, 1963), 152.
- ¹⁹ *Ibid.*, 157.
- ²⁰ Passmore, *The Perfectibility of Man*, 257-8.
- ²¹ See, for example, Richard Dawkins, *Unweaving the Rainbow* (London: Penguin, 1998), 1-6.
- ²² John Polkinghorne, "Cloning and the moral imperative", in *Human Cloning: Religious Responses*, ed. Ronald Cole-Turner (Louisville: Westminster John Knox Press, 1997), 38.
- ²³ See for example the comments of the ethicist Norman Fost, cited in *Science and Theology News*, July/August 2004, 10.

- ²⁴ Janet Martin Soskice, "The ends of man and the future of God", in *The End of the World and the Ends of God*, eds. John Polkinghorne and Michael Welker (Harrisburg: Trinity Press International, 2000), 78.
- ²⁵ Cited by Isaac Kramnick, "Eighteenth-century science and radical social theory: the case of Joseph Priestley's scientific liberalism", in Schwartz and McEvoy, *Motion Toward Perfection*, 57-92, on 68.
- ²⁶ Fukuyama, *Our Posthuman Future*, 90.