LIBERAL EUGENICS

In Defence of Human Enhancement

Nicholas Agar

Blackwell Publishing

LIBERAL EUGENICS

For Laurianne

LIBERAL EUGENICS

In Defence of Human Enhancement

Nicholas Agar

Blackwell Publishing

BLACKWELL PUBLISHING
350 Main Street, Malden, MA 02148-5020, USA
108 Cowley Road, Oxford OX4 1JF, UK
550 Swanston Street, Carlton, Victoria 3053, Australia

First published 2004 by Blackwell Publishing Ltd

Library of Congress Cataloging-in-Publication Data

Agar, Nicholas.
Liberal eugenics : in defence of human enhancement / Nicholas Agar.
p. cm.
Includes bibliographical references and index.
ISBN 1–4051–2389–3 (hardback : alk. paper) — ISBN 1–4051–2390–7 (pbk. : alk. paper)
1. Eugenics. I. Title.

HQ755.A29 2005
363.9′2—dc22

2004007788

A catalogue record for this title is available from the British Library.

Set in 10.5/13pt Minion
by Kolam Information Services Pvt., Ltd, Pondicherry, India
Printed and bound in the United Kingdom
by MPG Books Ltd, Bodmin, Cornwall

The publisher's policy is to use permanent paper from mills that operate a sustainable forestry policy, and which has been manufactured from pulp processed using acid-free and elementary chlorine-free practices. Furthermore, the publisher ensures that the text paper and cover board used have met acceptable environmental accreditation standards.

For further information on
Blackwell Publishing, visit our website:
www.blackwellpublishing.com

Contents

Preface and Acknowledgements

Many of my friends and colleagues were somewhat incredulous when I told them that I was writing a book defending eugenics. The word 'eugenics' has acquired some ugly associations since it was coined in the late nineteenth century. Francis Galton defined it as the science of improving human stock. The suggestion that we should be making humanity better may not sound particularly objectionable, but any semblance of innocuousness was removed by the actions of Galton's most thorough disciple, Adolf Hitler. Although other twentieth-century eugenicists killed far fewer people than Hitler, they did not hold back on imposing their visions of human improvement on others.

The improvement of human stock is no business of the eugenics that this book preaches. Indeed, I do not presume to make any judgements about what to count as such an improvement and how it might be accomplished. Twentieth-century eugenicists thought that bettering humanity would require the strict regulation of reproduction. The eugenics defended here differs in being primarily concerned with the protection and extension of reproductive freedom. Reproductive freedom as it is currently recognized in liberal societies encompasses the choice of whether or not to reproduce, with whom to reproduce, when to reproduce, and how many times to reproduce. What I call *liberal eugenics* adds the choice of certain of your children's characteristics to this list of freedoms. At the book's centre are powerful genetic technologies that will enable prospective parents to make such a choice.

There seems to be a big difference between a programme of eugenics that radically restricts reproductive freedom and one that would dramat-

ically extend it. Some distinctions are clearer in principle than they are in practice, however. We will need to ensure that the differences between liberal eugenics and its authoritarian precursor run deeper than rhetoric while remaining alert to new dangers brought by liberal eugenics. Individuals can make bad eugenic choices just as surely as states can. Our understanding of the harms that such choices may lead to is handicapped by a lack of historical examples of societies committed to giving prospective parents free access to genetic technologies. Writers of novels and screenplays have used their imaginations to fill the gap. They see a host of moral dangers. In the movie *GATTACA*, free access to enhancement technologies has created a society divided into genetic haves and genetic have-nots. What you can be and whom you can marry are set by the enhancements your parents have purchased for you. In Margaret Atwood's 2003 novel *Oryx and Crake*, a free market in human biotechnology leads to the end of human civilization.

Do I think that the fears provoked by these imagined futures are groundless? It would be glib to just assert that the new genetic technologies turn out to be entirely morally unproblematic. While I am confident of rebutting the objections that many opponents of eugenics take to be decisive, I recognize that unprecedented power brings unprecedented dangers. This book does not propose that individuals be given an unrestricted choice of characteristics for their children. Indeed, the same arguments that I use to establish the freedom to make eugenic choices will also set its limits.

I hope at a minimum that this book encourages people to take the idea of liberal eugenics seriously. Hitler and *GATTACA* have made eugenics an unpopular idea. However, being unpopular is not the same as being wrong. Philosophers lack the experimental apparatus that enables physicists to test unpopular hypotheses. The only way to make the thesis of liberal eugenics fit for trial in the court of moral opinion is to vigorously argue for it. How the new genetic technologies should be used on human beings is likely to be a defining moral question of the coming decades. Although there can be no one-off vindication of a view with implications as far-reaching as liberal eugenics, I hope at least to establish it as one of the major alternatives.

This book has benefited from the comments and criticisms of colleagues and friends at every stage in its writing. A number of people gave me written feedback. David Wasserman provided probing, sceptical comments on every chapter. A significant part of the process of writing the

book was my responding to his searching inquiries. Stuart Brock, Joseph Bulbulia and Jessica Hammond read and commented on near complete drafts, forcing me to re-examine and strengthen the book's exposition of ideas and argument in many places. Ruth Anderson, Nick Bostrom, Diana Burton, Tony Fielding, Caroline ffiske, Bette Flagler, Jeff McMahan, Laurianne Reinsborough and Katzen Schlect provided philosophical and stylistic pointers on many chapters. I profited also from feedback of a less formal nature. This was provided by my colleagues in presentations of some of the book's ideas to the Victoria University of Wellington philosophy programme seminar and by students in my Ethics and Genetics class. Special thanks must go to Nick Bellorini for his enthusiasm about the project. He both excellently discharged his duty as editor and offered insightful criticisms. I benefited also from the advice of anonymous referees for the press.

CHAPTER 1

Genius Sperm, Eugenics and Enhancement Technologies

In 1978, Robert K. Graham, millionaire inventor of shatterproof eyeglasses, set up the Repository for Germinal Choice on the grounds of his Southern Californian estate.[1] The Repository would offer the sperm of exceptional men to women unable, or unwilling, to become pregnant by their husbands. Graham's initial ideas about where to find his 'genius sperm' led the media to rebaptize the Repository, the 'Nobel Prize sperm bank'. However, Nobel laureates proved reluctant donors. Only one of the couple of dozen Californian prize winners approached by Graham ended up contributing his germinal fluid. Therefore, Graham relaxed his criteria. He petitioned the younger scientists who he predicted would be the Nobel laureates of the future. He also took sperm from Olympic athletes and successful businessmen. The Repository did a better job of attracting the attention of journalists than it did customers, and it was shut down in 1999, two years after Graham's death. At the end of its twenty years of operation, the Repository's tally stood at just over two hundred children.

Graham's customers were prepared to pay for the sperm of men who excelled in science, business and sports because they hoped to have children who would also excel in science, business and sports. But what was in it for him? There must have been more lucrative paths open to the successful inventor. Graham was chasing a dream. He hoped that the Repository would be followed by other genius sperm banks, and that jointly they would arrest a calamitous decline in the quality of human genetic material. In his 1970 book, *The Future of Man*, Graham argued that twentieth-century healthcare systems and social welfare programmes were preventing natural selection from purging the feeble and preserving

the strong. He feared that, unless checked, the welfare state would lead to universal mediocrity and communism. Anecdotal evidence suggests that Graham had a small degree of success. When David Plotz, a journalist with the online magazine *Slate*, matched some of the Repository children with their donors, he found that at least a few were taking after their high-achieving fathers. Three children of an Olympic gold medallist were very athletically talented. The sperm of science and mathematics professors had given rise to children gifted in these areas. Children conceived with the sperm of donors described as having happy temperaments were reported to be habitually upbeat.

This book investigates the idea of human enhancement that motivated Graham to establish the Repository for Germinal Choice. I defend the liberal view suggested by the Repository's full name. More specifically, I will argue that prospective parents should be empowered to use available technologies to choose some of their children's characteristics.

A sperm bank is a clumsy tool of choice. Graham's customers may have attributed the intelligence or happiness of their children to their selection of sperm, but how they raised them is likely to have made at least as significant a difference. Prospective parents may soon have technologies that give them greater power to choose what kinds of children to have. In the future, a woman who wants a brilliant child will not be restricted to the random selection of a genius's genes in the sperm that happens to fertilize her egg. She might choose to get pregnant with a genetic copy, or a clone of the genius. Alternatively, she may be empowered to search out the specific genes linked with genius, and have these engineered into her embryo.

If cloning and genetic engineering come anywhere near to meeting the expectations of writers of science fiction they will enable choices quite unlike those humans have made in the past. In chapter 2 I will address the question of what we can realistically expect of human genetic engineering and cloning as technologies of enhancement. I will argue that we should prepare ourselves for futures in which science fiction expectations are met. This presents us with the problem of how to make good moral choices about the technologies. The *method of moral images*, which I describe and defend in chapter 3, achieves this end by reducing the strangeness of the technologies of enhancement. There are not yet any human beings who have been genetically engineered to be very intelligent; nor have any geniuses been cloned. Nevertheless, we can understand the morality of these undertakings by constructing moral images of them. The activities

referred to by moral images must have two properties. First, they must resemble the practices at issue in relevant respects. Second, we should have secure moral intuitions about them. Under these circumstances, we are justified in transferring moral judgements from familiar to unfamiliar practices. Exploring the limits of the freedom to choose children's characteristics will involve testing many moral images. The liberal position I defend is defined as much by what it bans as by what it permits. The very same moral images that establish the freedom to choose children's characteristics will also help us to understand why some choices should not be permitted.

TWO KINDS OF EUGENICS

Human cloning and the genetic engineering of human embryos are technologies of the future. But the idea of human improvement has a past. Graham was practising *eugenics*, defined by its nineteenth-century inventor, Francis Galton, as 'the science of improving stock, which is by no means confined to questions of judicious mating, but which . . . takes cognisance of all influences that tend in however remote degree to give the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable than they otherwise would have had.'[2] Galton thought he knew how this improvement in human stock was to be achieved. He shared with his cousin, Charles Darwin, a fascination for human evolution. But while Darwin's main interest was in describing the forces that have shaped us and other living things, Galton was intent on harnessing them to human improvement. He dreamed of a social system that would not hinder natural selection, but would instead help it to make better humans.

Galton could not have foreseen the evil that would be done in eugenics' name.[3] This evil took its most concentrated form in the racist doctrine of human perfection promoted by the Nazis. Hitler's *lebensborn* or 'life spring' project was supposed to increase the number of blue-eyed, blond Aryans by mating racially screened women with SS men and officers in the German regular army. Room had to be created for these superior beings and their purified blood-lines protected from taint. In the early part of the Nazi era, enforced sterilization and legal bans on the intermarriage of superior and inferior humans were the preferred means of excluding bad hereditary material. Later, death camps were judged more expedient.

Some of Graham's rhetoric seems disturbingly similar to that of the Nazis. He appears to have been a racist, a believer in the superiority of Europeans. Notably, all of Graham's sperm donors were white. Among them was the notorious William Shockley, Nobel laureate co-inventor of the transistor. Upon his death in 1989, Shockley's wife reported that he considered his most important work to be, not his enormous contribution to the computer revolution, but his investigation of race differences in intelligence. Shockley thought that bad hereditary factors were disproportionately located in the genomes of black people. He also argued that any successful American eugenics programme would need to address the fact that the people least well equipped to survive had the highest reproductive rates.

But the name of Graham's business, the Repository for Germinal *Choice* , signals an important difference between him and the Nazis. The Nazis' eugenic template was inflexible. 'Nordic bearing', being of good build without 'disproportion between the lower leg and the thigh or between the legs and the body', freedom from alcoholism, 'absence of the Mongolian fold (inner epicanthic eyefold)' and 'reproductive capability' appear on a list of traits sought for entry into Hitler's SS.[4] They were also the goals of Nazi race science. Graham may have bemoaned the dysgenic tendencies of the modern welfare state, but he did not actively seek to prevent the reproduction of the hereditarily poor. The genius sperm went only to women who wanted it. Graham himself was a fan of the hard sciences, and the men he first approached for sperm reflect this bias. The reluctance of Nobel laureates to part with their germinal fluid was certainly one reason he cast his net wider. But customer demand was another. Women came to the Repository with their own ideas about the kinds of children they wanted. Some were after scientific genius, but others sought athletic talents or good looks, and still others sunny temperaments. Graham is reported to have approached Prince Philip of Britain for a sample of his genetic material. Apparently, the prince rebuffed this particular attempt to add breadth to the Repository's offerings. Moreover, Graham did not appear to hold ordinary folk in complete contempt. Among the maths prodigies and business successes on the Repository register is a man reassuringly nicknamed 'average guy'. 'Average guy' turns out to have had a better reproductive record than any of Graham's Nobel laureates. There was never a successful insemination using sperm from a Nobel laureate, but 'average guy' sired a dozen children.

Those whose vision of human enhancement emphasizes individual choice tend to avoid the term 'eugenics'.[5] They want language that clearly distinguishes them from the Nazis. But this smacks of Orwellian redefinition. Both approaches are broadly true to Galton's original conception of human improvement. Anyone advocating such a programme must demonstrate an awareness of the errors of the past. To adapt a saying of the philosopher George Santayana, those who do not learn from the history of human enhancement may be doomed to repeat it. And it is not enough to avoid Nazism. Eugenics was practised in other parts of Europe and in the United States.[6] In all of these places, race and class prejudice was permitted to dictate whose reproductive efforts would be encouraged, and whose would be hindered. While some Americans were competing for the titles of 'fittest family' and 'best baby', the courts were forcibly sterilizing other Americans on the grounds of congenital stupidity or criminality.[7] Retaining the label 'eugenics' makes obvious our obligation to show how what we are contemplating differs from the programmes of Galton's twentieth-century disciples.

Hitler showed us exactly where eugenics in pursuit of a racial ideal could lead us. However, I will argue that switching attention from races and classes of humans to individuals provides a version of eugenics worthy of defence. We would be rejecting *authoritarian eugenics*, the idea that the state should have sole responsibility for determining what counts as a good human life, in favour of what I will call *liberal eugenics*. On the liberal approach to human improvement, the state would not presume to make any eugenic choices. Rather it would foster the development of a wide range of technologies of enhancement ensuring that prospective parents were fully informed about what kinds of people these technologies would make. Parents' particular conceptions of the good life would guide them in their selection of enhancements for their children.

The freedoms that define liberal eugenics will be defended in the same fashion as other liberal freedoms. Liberal societies are founded on the insight that there are many different, often incompatible ideas about the good life.[8] Some seek huge wealth, others enlightenment; some devote themselves to their families, others to their careers; some commit to political causes, others to football teams; some worship God(s), others would rather go fishing. And this is only to begin to describe the variation in the kinds of lives that people choose for themselves. Living well in a liberal society involves acknowledging the right of others to make choices that do not appeal to us. John Robertson defends a procreative liberty,

which he understands as individuals' freedom to decide whether or not they become parents and to exercise control over their reproductive capacities.[9] His arguments are motivated by the recognition that one of the most significant choices that people make about their lives concerns whether or not, with whom, when, and how often they reproduce. We have invented a range of technologies to assist us in making these choices. Contraceptive technologies help those who want sex without reproduction. Infertility treatments help those who want reproduction but cannot use sex to achieve it. Genetic technologies currently being developed may give us the power to choose some of the characteristics of our children. Nazi eugenicists would have used these technologies to dramatically curtail reproductive choice. Only a narrow range of human beings would have been deemed worthy of cloning; genetic engineering would have been imposed on couples whose reproductive efforts were deemed incapable of producing children sufficiently close to the Nazi ideal. But liberal eugenicists propose that these same technologies be used to dramatically enlarge reproductive choice. Prospective parents may ask genetic engineers to introduce into their embryos combinations of genes that correspond with their particular conception of good life. Yet they will acknowledge the right of their fellow citizens to make completely different eugenic choices. No one will be forced to clone themselves or to genetically engineer their embryos.

The fact that eugenics has its strongest associations with one of the most illiberal regimes of the twentieth century makes the term 'liberal eugenics' seem an oxymoron. Showing that the differences between liberal eugenics and Nazi eugenics run deeper than rhetoric will require careful attention to how the social and economic realities of liberal societies may subvert individual enhancement choices.

TECHNOLOGICAL POSSIBILITIES

One difference between liberal and Nazi eugenics is that between pluralistic and monistic views of human excellence. Another lies in the technological means available to mid-twentieth-century Nazi eugenicists and the liberal eugenicists of the future.

Suppose that the Nazi programme of human enhancement had not been terminated by Germany's military defeat. Hitler could never have realized his eugenic ideals, simply because the Nazi science of human

heredity was hopelessly wrong. A text called *Human Genetics*, written jointly by geneticists Fritz Lenz and Erwin Baur, and an anthropologist, Eugen Fischer, served as a repository of Nazi wisdom about heredity. According to this work, genetics would explain why it was that Jews are prone to 'fraud and the use of insulting language', why Negroes were lazy, and why 'the Mongolian character . . . inclines to petrifaction in the traditional'.[10] The race scientists hoped that an understanding of heredity would enable programmes that would replace these vices with the Nordic virtues. However, it is wrong to think that the biological distinctions between people of different ethnicities mark a distinction between vice and virtue. One of the most salutary lessons of the new genetics has been the biological closeness of people who look very different. Humans share 99.99 per cent of their genetic material.[11] That leaves room for about 2.1 million genetic letters to vary from individual to individual. But the pattern of even this comparatively small amount of variation is a disappointment for scientific racists. In the early 1970s, the geneticist Richard Lewontin showed that only a small part of overall human genetic variability is between what we think of as different races.[12] From the standpoint of genetics, the differences between Africans, Asians, Europeans and the members of other races are almost invisible. All of this shows that a programme of depressing the reproductive rates of the members of some cultures and boosting that of others could not achieve the end of encouraging virtue, whatever one's conception of it.

Our understanding of human heredity has come a long way since the Nazi era. The experts on human genetics consulted by the prospective parents of tomorrow's liberal societies will give vastly better scientific advice than that given by Hitler's scientific lackeys. A collection of technologies that I will call *enhancement technologies* will enable the selection and manipulation of human traits by selecting and manipulating the hereditary factors that contribute to them.[13]

The most topical of these technologies is cloning. A clone is a genetic copy of another organism. The modern history of cloning begins on 5 July 1996 with the birth of a sheep called Dolly. Dolly was the first mammal successfully cloned from an adult cell, produced by a method known as *somatic cell nuclear transfer*. Her embryo was made by transferring the nucleus of an adult body cell into an egg whose nucleus had been removed. This procedure rejuvenated the genes of the adult cell, enabling them to start life all over again. Before Dolly, this rejuvenation was thought to be a biological impossibility. This is part of the reason for

the surprise that greeted her. But even those not at all concerned about science had some idea about where Dolly could lead. The register of cloned mammals now includes sheep, cows, cats, goats, mice, pigs, horses and mules. Although each of these species has presented its own technical challenges experimenters have overcome them. As biologists like to remind us, humans are just another species of mammal. We are just another challenge for cloners.

Advocates of the technology give a range of reasons for cloning humans. Some tout cloning as a means of creating human embryonic stem cells. This so-called 'therapeutic' cloning would involve the creation of a clone embryo from the cell of a patient requiring transplant tissue. The clone would be allowed to develop to the blastocyst stage, at which point it consists of some two hundred cells. The embryonic stem cells that would now be harvested combine two remarkable powers. Their pluripotency means that they can, in theory, be turned into any type of tissue that the patient might require. The fact that they come from an embryo cloned from the patient should make the new tissue a perfect immunological match. If all goes according to plan, doctors will acquire the powers of automotive mechanics. Mechanics replace a seized gearbox with one up to the standard of the original on the day the car was driven out of the factory. Doctors practising 'regenerative medicine' will provide brand new kidneys, pancreases and hearts that are perfect matches for their recipients. Therapeutic cloners must overcome many scientific obstacles before they open an era of regenerative medicine. In addition, they must also overcome moral obstacles. As we will see in chapter 3, opponents challenge the label 'therapeutic cloning', arguing that it obscures a dark side of the procedure. What they would call 'research cloning' necessarily involves the destruction of human embryos, and so the killing of very young human beings.

While therapeutic or research cloners would stop the development of the embryo well before it has any recognizable human features, others hope to turn clone embryos into clone babies. Dolly's presentation to the world in early 1997 triggered a race to create the first human clone child. The most enthusiastic public advocates of what is known as reproductive cloning are an organization known as CLONAID. In late 2002 and early 2003 CLONAID announced, but refused to confirm, the births of three human clones.

Creating a human clone baby would be a scientific coup. But is there a reason for doing it other than to demonstrate that it can be done? Some

see reproductive cloning as a treatment for kinds of infertility intractable by other means. Men who produce no sperm and women left without eggs have nothing for practitioners of in vitro fertilization to work with. However, cloners could make children for them out of cells taken from almost any part of their bodies. Those behind CLONAID have more exotic ambitions. The organization was founded by the Raelians, a UFO cult whose creation myth describes aliens' invention of humanity by cloning. They are vague about what the human species was cloned from. For the Raelians cloning is something more than a means of treating infertility. It is the technology of eternal life. The CLONAID website announces: 'Once we can clone exact replicas of ourselves, the next step will be to transfer our memory and personality into our newly cloned brains, which will allow us to truly live forever.'[14] Much of their funding comes from people sufficiently enticed by this vision to pay the asking price of US $200,000.

Cloning by somatic cell nuclear transfer might also serve the purpose of enhancement. In the wake of the first successful cloning of frogs in the early 1960s, the distinguished British biologist J. B. S. Haldane suggested that we select the most talented human beings for cloning.[15] He thought it wise in most cases to wait until candidates were in their fifties so as to be sure that their genomes really warranted repetition. Haldane allowed that athletes and dancers might be cloned younger, and suggested that if we were aiming to boost longevity we should clone healthy centenarians. He thought that this measure might 'raise the possibilities of human achievement dramatically'.[16] A programme for the mass improvement of human stock sounds like something of which Hitler would approve, something inimical to reproductive freedom. But it is not hard to imagine how cloning might promote individual enhancement agendas. The technology presents an option that will appeal to those with the right combination of humility and commitment to a eugenic ideal. While combining your egg or sperm with the sperm or egg of a talented person may offer some chance of having a talented child, cloning improves the odds. You could choose an embryo that would be a genetic duplicate of a certified genius or sports star, and thereby not dilute high-quality genes with your own more lowly genetic material. Were Graham to have opened the Repository for Germinal Choice in the year 2078 he might have collected a Nobel laureate's skin cells rather than his sperm. He might have extracted the nucleus of one of these cells, placed it in an enucleated egg, and put the resulting embryo in the womb of a woman in pursuit of Nobel excellence.

Cloning can serve the end of human enhancement so long as the traits that parents want for their children are influenced by genes. Replicating all of a person's genome reproduces, in a new person, all of the genetic influences that helped shape her. Another biotechnology might enable more precise choices of hereditary influences. This is the biotechnology of genomics, whose task is to describe hereditary material. On 26 June 2000 the publicly funded Human Genome Project and the private Celera Genomics announced the completion of drafts of the collection of all human DNA, the human genome.[17] Work continued and on 14 April 2003 members of the International Human Genome Sequencing Consortium, an organization combining the research efforts of eighteen institutions, believed they had progressed to the point of 'completing' the map.[18] The human genome had been described to 99.99 per cent accuracy. The job of identifying all the human genes and determining their functions remains.

The technique of Pre-implantation Genetic Diagnosis (PGD) enables parents to put genomic information to use. PGD involves the fertilization by IVF (in vitro fertilization) of a number of a woman's eggs. One or two cells are separated from the embryos that result, and are tested for the presence of particular genetic variations. Doctors then introduce only embryos that lack the genetic variants the woman is trying to avoid or that possess the variants that she is seeking.

PGD allows parents-to-be to choose from the variation provided by nature. Genetic engineers may allow them to improve on nature. They would insert genes linked with traits valued by parents into the genomes of their future children. Although diseases have been the early focus, the most morally challenging uses of genetic engineering are driven by an ambition that reaches beyond treating disease.

Consider Doogie, a breed of mouse whose genome has an extra copy of a gene called NR2B[19] The breed's name signals a resemblance between it and the television teen genius, Doogie Howser MD. Joe Tsien, Doogie's Princeton University creator, tells us that the mice acquire new knowledge twice as fast, and retain it for around four to five times as long as their normal counterparts. Doogie's creators offer an explanation for the breed's cognitive talents. Memory involves establishing links between bits of information stored in different parts of the brain and the additional copy of NR2B appears to make brain tissue more connective. The greater number of connections allows the mouse to lay down memories more easily, and to hold on to them for longer. Some researchers at Harvard, more concerned with muscles than brains, have created Schwarzenegger

mice.[20] This feat was achieved by adding an additional copy of the gene that produces a protein associated with muscle growth known as insulin-like growth factor type 1 (IGF-1). Mice with additional IGF-1 not only gain muscle with little exercise, but seem immune from the muscle wasting normally associated with aging.

NR2B and IGF-1 exist in humans. Both research teams speculate about what might be achieved by giving humans additional copies of these genes. Tsien hopes that genetic engineers might one day insert additional NR2B genes into human brain cells to repair the damage done by Alzheimer's and Parkinson's. The Harvard team speculates that IGF-1 offers a biotech solution to muscular dystrophy, a condition characterized by fatal muscle wasting. It is easy to see why scientists fighting for research funding should emphasize the less controversial, therapeutic potential of their work. But there is nothing in nature, no stop sign built into the human genome, limiting these techniques to the treatment of disease. Tsien says that Doogie 'points to the possibility that enhancement of learning and memory or even IQ is feasible through genetic means, through genetic engineering'.[21] The Harvard scientists' choice of the nickname 'Schwarzenegger' indicates an awareness of one potential use of their technique. If you can make Doogie and Schwarzenegger mice, then why not go ahead and make real Doogies and replacement Schwarzeneggers?

Although this brief discussion of enhancement technologies makes us aware of their potential power, we should also be aware of their limitations. Some limitations are inherent in the science on which the technologies rely. Journalists tend to describe the possibilities of human biotechnology as if they are only a few experiments away from being realized. In chapter 2 I will describe some of the obstacles in the way of cloning geniuses or inserting additional NR2B genes into human embryos. Other limitations have more to do with us, or at least with our expectations of the technologies. The popular imagination tends to oversimplify the new technologies to make more apparent their potential perils and dangers. We are encouraged to think that all biotechnologists have to do to make a genius is to find the right genes and insert them into a suitable embryo, and that Einstein's clone would, of necessity, achieve scientific breakthroughs on a par with those of Einstein. This is *genetic determinism*. It is based on a misunderstanding about the significance of genes in making persons that overstates what enhancement technologies can achieve. Genes certainly influence intelligence, but they are not the only influence. We will not arrive at sensible moral guidelines for enhancement