Genetic Engineering: the unnatural argument

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Introduction

The assertion that genetic engineering is wrong because it is unnatural strikes a chord with many people and, I think, encapsulates why they have a gut reaction against the technology. However, it is dismissed by regulators and many philosophers (eg. Straughan 1999), because they fail to examine how 'unnatural' and 'natural' are actually used in the context of technological practices. Instead, they focus on one or both of the two principal meanings of 'nature' given by John Stuart Mill (Mill 1904): nature is "the collective name for everything which is," in which case we cannot do anything that is unnatural; or "it is everything which is of itself, without voluntary human intervention," from which it follows that everything we do in a planned, considered way is unnatural. In contrast to these two meanings people do actually regard some technological products or practices as being more natural than others: organic farming is considered more natural than 'conventional' agriculture; wool, cotton and silk are 'natural' fibres whereas acrylic and polyester are not, and one particular technique for avoiding conception is termed 'natural birth-control' whereas the contraceptive pill would never be called 'natural.' Rather than dismissing such terminology as the product of romantic ignorance, I would like to pay attention to what 'unnatural' and 'natural' mean in these contexts. This I will do by considering the characteristics of the three sets of technologies mentioned above. I will then argue that genetic engineering can be said to be unnatural and put forward three reasons why the unnaturalness of a technology makes it morally suspect.

Natural and unnatural technologies

Natural methods of birth control involve the woman coming to understand when she is fertile and avoiding sexual intercourse during that period of her menstrual cycle. Human behaviour adapts itself to nature in order to achieve the outcome that the human desires. In contrast, the contraceptive pill interferes with the woman's menstrual cycle so that she can have intercourse at any time of the month without getting pregnant. Rather than human behaviour, nature (the woman's body) is modified and changed.

The term "natural fibres" refers to materials such as wool, cotton or linen which are produced by animals or plants and prepared for use by human action, as opposed to synthetic fibres such as nylon and polyester, which are synthesised

from simple chemicals in industrial processes. The production of "raw" natural fibres depends on the processes of living nature: the fibre-providing animals or plants grow by their own organic process; humans simply try to ensure that the necessary conditions are available for this to happen. I say "try" because in fact many of the necessary conditions are not under human command: we do not control the weather, for example. The human effort is more one of trying to understand the complex natural systems, to make use of what happens and what is produced naturally, and to channel it to our purposes. By contrast, in the production of synthetic fibres we feel we have complete control over the whole process because the chemical and physical processes used are inherently less complex and therefore more possible for us to understand conceptually than biological processes. We can accurately specify the conditions of temperature, pressure and reactants under which the processes occur and can provide these within simple, closed systems which can be closely monitored and controlled. These systems and processes allow us to produce substances that are unnatural in the sense that without human action they would not exist at all on earth.

In agriculture, organic farming techniques are considered more natural than modern chemical farming technology which uses pesticides and inorganic fertilisers. Both aim to provide suitable conditions for natural biological processes to occur – for crop plants and livestock to grow. But organic farming relies on natural processes, *i.e.* on ecological relationships to control pests and on soil microbiology to provide plant nutrients (through the breakdown of organic matter), whereas chemical farming uses synthetic chemicals as substitutes for specific, discrete processes in the ecosystem. As the application of these chemicals is fully under the control of the farmer, chemical farming seems to give the farmer more control than organic farming does. This has enabled the farm to become like a factory, with a one-way flow of inputs of chemicals and energy at one end and outputs of a limited number of "products" at the other. Of course there are other outputs apart from the desired wheat grain, beans, meat or fibre, but these are classified as "wastes." In this system, monoculture on a scale not conceivable before is made possible. In contrast, traditional and organic agriculture normally has to involve a variety of crops and processes. The farm has to be run as an integrated cyclical system where "wastes" from some processes form inputs into others.

The above discussion suggests several strands to the natural/unnatural distinctions made with regard to human technologies:

- natural methods typically depend on biological processes and interactions which occur in living nature, whereas the paradigm cases of unnatural technologies are based on physical/chemical processes;

- natural methods have typically been developed through experiential understanding of those processes over many years of practice of the method, though this understanding may be enhanced by insights from scientific research, whereas the development of unnatural technologies has been based upon scientific theories about physical/chemical processes (or biological processes seen as reducible to physical/chemical ones);
- because chemical/physical processes are simpler and therefore easier to understand conceptually (*i.e.* scientific theories can give a more complete description of them) they are easier to control and manipulate: when we employ unnatural methods we feel that we have more control over the outcome than when we use natural methods;
- while natural methods involve humans understanding natural processes and then adapting their behaviour or channelling the natural processes to meet human ends, unnatural methods aim to give human behaviour a freer rein: nature is to be altered to suit human behaviour, institutions and practices, so the latter are freed from the constraints imposed by nature;
- this freedom has been used to create new kinds of things that have not before existed in living nature: things that are novel.

I would like to stress that all of these strands are matters of degree, of more or less, not either/or: naturalness and unnaturalness are relative, not absolute. I also recognise that they are not rigorous criteria, more pointers to what may be meant by natural/unnatural when it comes to technology. Although the strands are interrelated, the position of a particular technology on the unnatural/natural spectrum may depend on which particular strand you consider. It may not therefore be possible always to rank technologies relative to each other on a single scale of 'naturalness.'

Is genetic engineering an unnatural technology?

Using these distinctions, can genetic engineering be called unnatural? Here I take genetic engineering to be the practice which seeks to produce altered organisms through direct intervention at the level of the DNA of the organism, by means of laboratory methods such as recombinant DNA technology. It certainly uses living biological systems and is not an attempt to replace such systems with physical/chemical processes. However, it is based on the idea that biological processes are essentially reducible to physical/chemical ones, and therefore in principle amenable to being controlled by us to a similar degree. So the characteristics, properties and capacities of each living organism are regarded as

'encoded' by the organism's DNA sequence: being able to change that DNA is the key to having control over what a living organism is.

The rationale behind genetic engineering is that nature should be altered to suit human practices and institutions. The institutional context within which the technology is being developed (market economies dominated by large corporations) has defined the practices that organisms are to be genetically engineered for. Thus amongst the first genetically modified crops have been soya beans resistant to specific herbicides, and tomatoes that do not rot and thus have a longer shelf life. There is also interest in engineering peas to make all the pods on a plant ready at the same time. These are "improvements" to these plants only in the context of certain agricultural and food industry practices: the use of herbicides to keep down weeds, long distance transport of food from field to shop, and mechanised harvesting.

This rationale is, of course, shared by traditional plant and animal breeding practices, which thus also have an element of unnaturalness about them. What makes genetic engineering different is that it does not simply make use of processes which occur in nature – it is not natural selection consciously put to human ends and thus rendered artificial or methodical, as Darwin termed it (Darwin 1905). Pure DNA (*i.e.* DNA stripped of the proteins and other molecules normally associated with it) does not exist outside the laboratory. Its manipulation is not a variation of a process which occurs in natural systems; neither is the micro-injection of DNA into fertilised egg cells. These new methods enable us to create things that have not existed before: transgenic organisms, containing one or more genes from an unrelated species. Despite the protestations that species are fluid, changeable entities, that there are no 'natural species boundaries' for genetic engineering to cross (see for example Straughan 1999), no one denies that genetic engineering techniques enable movements of genes between species that could not have occurred before.

The methods of genetic engineering, it is claimed, overcome the limitations of traditional breeding practices. They are intended to greatly enhance the human abilities to control and change nature to suit human practices and institutions. In this respect they are much more unnatural than traditional breeding practices. Unlike traditional breeding genetic engineering is also unnatural in that it enables the creation of transgenic organisms: a step up from the sort of novelty that is possible with traditional breeding.

What is wrong with unnatural technologies

The term unnatural has overtones of moral disapproval. Similarly, the word exploitation is often thought to imply moral wrongness. However, it has been

argued (Wood 1995) that exploitation is not a moral term, but a descriptive one. To call something exploitation is not in itself to say that it is wrong, but the nature of exploitation, combined with particular moral beliefs, means that exploitation is, in many instances, morally wrong. This separation of the descriptive from the moral overcomes the charge of an is/ought confusion. The preceding sections have given some content to the term unnatural when applied to human technologies. This section will examine that content from an ethical standpoint to explore whether and how, given certain moral beliefs, moral wrongness follows from the unnaturalness of a technology, looking in particular at the example of genetic engineering. There are three aspects of unnatural technologies that I will consider: the attitude to nature that unnatural technologies embody; the novelty of the processes they involve and of the things that they make it possible for humans to produce, and their consequences for human social and economic structures.

Attitude to nature

Implicit in the move that unnatural technologies make from biological to chemical/physical processes, to enable greater control in the attempt to modify nature to fit in with human purposes, is the idea that nature is a constraint and limit on human action. The view exemplified by Francis Bacon's phrase 'conquer and subdue,' was that of nature as an antagonist, to be overcome and brought under our control (in Bacon's *Wisdom of the Ancients* "Erichthonius," Myth 20 - Robertson 1905:843)[1]. Also in this vein is the awe, verging on terror, at the vast, reckless power of nature that suffuses J.S. Mill's essay (Mill 1904). In contrast, a contemporary, post-modern view is that nature is simply a social construct – all 'natural things' are in fact merely constructed as such by human practices, and therefore there is no fundamental difference between the artefactual and the natural (see for example, Vogel 1996). On this view one cannot make the distinction I am proposing between 'natural' and 'unnatural' technologies, so there can be no moral difference between them.

In opposition to both the old idea of nature as an awe-inspiring antagonist and the post modern denial of a nature independent of human practices, the proponents of natural technologies, particularly of organic farming (the 'natural technology' that has been most written about) regard nature and nature's processes to be beneficial overall – though particular natural things or events may, of course, be harmful (see, for example Verhoog *et al* 2003, on the attitudes of organic

[1]Though it should be noted that Bacon argued against forcing nature to our will in order to 'conquer and subdue it;' this approach 'rarely attains the particular end it aims at' and Bacon recommends instead wooing nature with 'due observation and attention' (in Robertson, 1905:843).

farmers). Natural processes and living organisms have their own autonomy, an 'otherness' that is always, to some extent opaque to human understanding: nature 'lives and grows by itself' (Verhoog *et al* 2003, 39). Organic farmers regard nature as an autonomous partner, with whom they are co-operating, and who should be respected. This respect, like the respect that one owes a friend, is a moral duty. It also, though, has its pragmatic side (if one divorces moral reasons from pragmatic ones): the early organic movement argued that only organic methods (specifically the use of animal manures to replenish the humus content of the soil) would keep the soil healthy, and only a healthy soil would produce healthy crops, animals and people (see Conford 2001).

The organic movement thus argues that organic farming results in material improvements to human life, compared with conventional agriculture. One can also argue that the relationship to nature it embodies is of importance to human well-being in a constitutive, not merely an instrumental sense. In such constitutive relationships, what one has a relationship with (the other), because it is different from and independent of the self, offers resistance to and puts limits on the activities of the self. Not to respect those limits, but instead to seek simply to control and dominate the other, is to attempt to make the other into merely an extension of the self: something that exists simply to meet ends defined by the self. This denies the possibility of a relationship with the other, a relationship that could have enriched the self. The self is thus diminished if it denies otherness by not respecting the limits that the independence of others places on it (Plumwood 1993). Recognition of and respect for the otherness of natural processes is thus essential if we are to have a relationship with nature that can become part of who we are.

It is through engaging with living organisms and natural processes in technology that we encounter this otherness. Sometimes it is as a resistance to our preconceived plan, that then has to be adapted and modified to achieve our end: we must eat, but we can change our ideas of what we should eat according to what the environment we are in affords; the farmer or gardener can either do battle with pests (slugs in my case) or grow crops that are not so vulnerable to their attack. Otherness can also be encountered as an unexpected gift: the natural bounty that we have not worked for, that is simply there for the taking. Both would be lost if we truly mastered the otherness of nature and brought it under our full control.

Using more unnatural technologies means reducing the engagement of individuals and society as a whole with nature: we lose the encounter with the otherness of nature, diminishing our relationship with it and thus with ourselves. When we go from using wood to using plastic, or from wool to acrylic, we as a

society are no longer dependent upon, nor need to have interaction with, the forests where the trees grow or the sheep who provide the wool. Instead of forests and fields we need oil refineries and chemical factories. Ways of life that did involve engagement with nature are destroyed. Mark Sagoff points out that making us less economically dependent on the natural environment is indeed the intention of biotechnology. Genetic engineering would enable a huge range of products to be produced by cell culture techniques, dramatically increasing the degree to which industrial (*i.e.* unnatural) products replace those of agriculture, with the latter confined to the growing of biomass (Sagoff 1988).

This argument, that part of what is wrong about unnatural technologies is the attitude to nature that they embody – that they do not respect and value nature and natural processes, but simply seek to have controlled, predictable outcomes – is, like other arguments I am making, a relative one. Human life necessarily involves trying to have some control over our environment and the products of our labour. However, there is a vast difference between the primitive 'gardening' of hunter/gathers, that encouraged the growth of desirable plants and discouraged others, and the attempt to genetically engineer a plant so that it has a particular defined set of characteristics that we want it to have. Some forms of control respect the otherness of what we are engaging with: they seek to channel natural processes so they produce outcomes we desire, but are receptive to the qualities and properties of natural processes, materials or organisms and allow these to influence and constrain our desires. In contrast, other forms of control are not receptive in this way and seek rather simply to impose the human will on nature.

Novelty

To say that something is novel is to say that it is a new kind of thing, not simply that it is a recent incident of a general kind. Days and babies can be new but not novel (though genetic engineering raises the possibility of novel babies). This aspect of the unnatural gives a clear temporal dimension to the idea of nature. Nature is the 'pre-given' – even if it is a legacy of an earlier culture rather than a 'nature' free from human intervention (Soper 1995, 187). In a related way the natural is the ordinary, the normal (Mill 1904, 30). Here nature is clearly given a relative, rather than an absolute meaning: the degree of unnaturalness depends on the newness of the novel (*i.e.* new kind of) thing and on the extent to which it is different in kind from what has gone before.

If something is novel then it is something that we have no experience of. We therefore cannot use our past experience as a guide to what will happen and what we should do. In the case of the processes and products of unnatural technologies, what we use instead of such experience when we think about what the impacts of these technologies might be is the scientific knowledge –

conceptual understandings or theories – on which these technologies are based. In doing this we are assuming firstly that our theories give adequate descriptions and understandings of the relevant phenomena, and secondly that we know what the relevant phenomena are: that we know which areas of knowledge are pertinent to the question of what the effects of the particular novel process or product will be. These assumptions are highly questionable. The experience of environmental concerns over the past century, for example, is that many of what have turned out to be the most serious impacts of new technologies were not, and probably could not have been predicted when those technologies were introduced. The classic case is the effect of CFCs (chloroflurocarbons) on the ozone layer. When these chemicals were first synthesised in 1928 no one would have considered atmospheric chemistry to be relevant to assessing the impact of a proposed refrigerant. CFCs were simply welcomed because they did not have the problems of flammability or toxicity associated with previous refrigerants (Colborn *et al* 1996, 243-245). We cannot assume that theoretical knowledge alone is capable of giving us an adequate understanding of the world. There will always be areas of 'irreducible ignorance,' which put limits on the possibilities of scientific knowledge: even with unlimited research, in some cases, we will not be able to predict the consequences of taking a particular course of action, in the sense of knowing all the possible outcomes and their probabilities (Faber, Manstetten and Proops 1992).

This concern about unnatural technologies is related to the former issue of the attitude to nature embodied by unnatural technologies. Nature should be recognised as an 'other' partly because it is to some extent opaque to human understanding. This inability of the human mind to fully understand nature was part of the Greek concept of *techne*. *Techne* involves being able to reason correctly on the basis of knowledge about the form of what is to be made and the matter it is to be made out of. However, Aristotle considered that it was only possible to know matter "up to a point" (*Physics* 2.2.194a23). In itself matter is unknowable. It is also not simply formless stuff, which any form can be imposed on, but it 'desires' or 'reaches out' for particular forms (*Physics* 1.9.192a18). The artisan must therefore be attentive to the particular matter being worked on, and allow the matter to guide the form of the artefact. Only then will the artefact approach the perfect union of form and matter that is characteristic of natural objects (Mitcham 1994, 118-123).

Genetic engineering's reliance on a particular conception of the role of DNA in the growth, development and final form of an organism[2] makes the technology particularly open to the charge that it is tampering with things we do not understand. This conception, in which organisms are regarded as collections of separate, distinct functions or properties, each determined by one or more genes, is a disputed one. Brian Goodwin, for example, proposes instead a conception of organisms as dynamic wholes, in which genes, through their specification of the particular form of proteins, influence the outcome of the process of growth: the proteins, and thus the genes which specify them, do not on their own determine particular characteristics of the organism (see Goodwin 1994). From this standpoint the results of transfers of genes from one organism to another are inherently unpredictable and Goodwin, with other scientists at a meeting in Penang, Malaysia in July 1994, called for a moratorium on the release of genetically modified organisms into the environment.

Unnaturalness is thus a way of talking about radical uncertainty, or ignorance about the effects of a new technology. It is not the only source of uncertainty in the world: the consequences of human actions are generally unpredictable, but we nonetheless have confidence in the future if we believe we will be able to cope with the range of things that are likely to happen. However, the novelty of unnatural technologies means that their effects may well be outside of the range of previous experience and perhaps the ability to cope of natural ecosystems as well as of human societies. These considerations urge a precautionary approach: one that recognises our ignorance and does not pursue an unnatural technology unless there are very good positive reasons to do so. Not to recognise ignorance in this context is arrogant; to proceed in spite of such ignorance without very good reason is reckless and irresponsible.

Social consequences

Any impact of a technology is a function of both the intrinsic nature of the technology and the context within which the technology is used. This is true for social as well as for environmental impacts. Thus, although the context of social institutions and relationships, such as property relations and the distribution of wealth, are important in determining the impact of a technology, the nature of a

[2]The conception of the role of DNA implicit in genetic engineering is that particular sequences of DNA (*i.e.* genes) determine particular characteristics of an organism through the specification of proteins, with a simple, one-to-one (in what is considered the normal case) relationship between the characteristic and the gene. Only within this framework can it make sense to attempt to create an organism with a desired new characteristic by introducing the 'gene' – *i.e.* the DNA sequence thought to 'encode' for that characteristic – into the genetic material of the organism.

technology may also be such that the technology will have a tendency to change human social and economic relationships in a particular way.

What happens when a more unnatural technology replaces a more natural one is that there is a reduction in the reliance on natural processes and an increase in reliance on products and processes that are humanly instituted and controlled. The latter products and processes are on the whole ones developed, informed and mediated by expert scientific knowledge of the kind which requires the support of government or large corporations for its growth and development. This, I think, means that, contrary to the idea that unnatural technologies increase human autonomy by transcending natural limits, it is generally the case, on the level of individual people, that the more unnatural the technology, the greater the reduction in the concrete experience of autonomy. While the autonomy of human society with regard to nature is increased, that of human individuals with regard to controlling human institutions is decreased.[3] As C.S Lewis said in 1947, "What we call man's power over nature turns out to be a power exercised by some men over other men with nature as its instrument." (Lewis 1947)

In the debate about genetically modified crops this aspect has been clearly recognised. Many are opposed to the technology because of the effects it would have on the power structures within agriculture, taking power away from individual farmers and giving it to the large biotechnology companies. However, I do think this is a general feature of unnatural technologies. It arises because natural technologies are generally based on more widely dispersed resources and knowledge and are more amenable to being carried out on a small scale. They are therefore inherently more likely to create a more equal distribution of wealth and power than unnatural technologies. This is not to say, of course, that a society using more natural technologies will necessarily have a more equal distribution of wealth than one using unnatural ones. Access to land and therefore natural resources can be artificially restricted by forms of property ownership which give a minority of people control over most of the land. Similarly, a society using unnatural technologies can institute employment laws and welfare benefits to give a more equal distribution of wealth. But in the former case social and institutional forces need to be mobilised to maintain an

[3]Thus, in *The Dialectics of Enlightenment*, Horkheimer and Adorno argue that the Enlightenment's attempts to dominate and thus liberate humans from nature paradoxically results in the domination of the human subject by "second nature" – human institutions and technology (discussed in Vogel, 1996). But this is only a paradox, *i.e.* a return of what has been suppressed, if the controlling human institutions are mistakenly regarded as "natural" and the human responsibility for them denied.

unequal distribution,[4] whereas in the latter they are needed to create a more equal one.

Conclusions

In conclusion, moral wrongness follows from the unnaturalness of a technology in virtue of: firstly, the attitude to nature that they embody, that seeks control over rather than respectful engagement with nature; secondly, the recklessness of using novel processes and products, the consequences of which we are inherently ignorant, or the arrogance of not being aware of this ignorance, and thirdly, the concentration of wealth and power in human societies and the reduction in the autonomy of human individuals brought about when a more unnatural technology replaces a more natural one. To the extent that a particular technology embodies these attitudes, is novel, and has these consequences for the relationship between human individuals and their natural environment, and thus human social and economic relations, it can be considered as ethically suspect.

It should be noted that none of the above involve regarding nature as a standard to be conformed to or a model to be followed. If there is an appeal to an independent nature it is to a particular conception of human nature, one that considers forms of human life that respect the otherness of nature, that seek to understand and adapt to the natural environment and that acknowledge the limits of theoretical knowledge, to be objectively better than ways of life that seek to control and dominate and that are arrogant about the extent of human powers and knowledge. Technology, which defines and embodies our concrete, practical relationship with nature plays an active, non-neutral role in determining our way of life, and is therefore is a matter of ethical concern. The "unnaturalness" of a technology is, I have argued, a set of characteristics which appears, on the whole, to render that technology ethically dubious. However, this does not mean that other criteria are not also relevant to the moral evaluation of technologies. None of the arguments advanced here are intended to imply that if something can be said to be 'natural,' it follows that it is necessarily good.

Postscript on feeding the world

In the section above on novelty I argued that our ignorance with respect to unnatural technologies means that we should not proceed with them unless there are good, overriding reasons for doing so. In debates about genetic engineering, what is often put forward as such a good reason is the need to feed the growing

[4]For example, those in power often need to use force to prevent occupations of land by the landless.

world population: genetic engineering is needed to increase the productivity of agricultural systems. I find such arguments extremely unconvincing.

Firstly, all the evidence suggests that the cause of hunger is not lack of food, but social inequalities – there is plenty of food, it is just that some people do not have access to it (see for example Kimbrell 2002). These social inequalities, I have argued, are increased, not decreased by unnatural technologies: genetic engineering is thus likely to increase, not decrease hunger. If lack of food were a problem, the easiest way to remedy it would be for livestock farming to become less intensive, using less imported feed and more extensive grazing on land unsuitable for crops (see McLaren, Bullock and Yousuf 1998 on the huge amount of land, often in countries where hunger is present, used to grow soya and other crops for UK livestock).

Secondly, many studies have shown that food production by small scale farming can be dramatically increased with organic methods and other 'agroecological innovations' (see Parrott and Marsden 2002, and Uphoff 2002). Such natural methods do not diminish the independence of small scale farmers because they do not rely on expensive internal inputs such as fertilisers and pesticides. They also increase food supply at the point where it is vulnerable to scarcity, on local markets in countries of the South.

Thirdly, nature, not the work of humans, is the source of productivity and abundance. Therefore understanding natural processes and working with rather than against them, using what nature provides rather than manufacturing something else, maintaining rather than destroying the productivity of natural systems, are all, in the long run, likely to provide more benefits for less effort.

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