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GENETIC ENGINEERING FOR THE ENVIRONMENT: ETHICAL IMPLICATIONS OF THE BIOTECHNOLOGY REVOLUTION

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The ethics of genetic engineering, or genethics in current jargon, is one of those areas of debate which needs to be constantly reviewed in the light of the rapidly expanding science of biotechnology. It could be argued that the revolution taking place within biology will be as significant to our existence as Newton's and Einstein's ideas were for physics. The concept of manipulation of *human* genes has led to considerable public debate and discussion amongst moral philosophers and theologians.(1) I intend, in this article, to concentrate on the relatively neglected area of genetic engineering as used for *agricultural* purposes, with particular reference to crop plants. The philosophical, theological and ethical implications of this application of biology are rather different from those pertaining to human beings and deserve separate attention. In particular, this technology has important environmental consequences, both in the short-term and the long-term. The possible long-term effects on the human community is equally significant, both directly in terms of North/South relationships and indirectly through environmental influences. These potential effects need to be considered a priori if theology/philosophy is to have any real bearing on future policy decisions.

The tendency amongst theologians and philosophers is to adopt what William Temple described as a 'middle axiom' approach when reflecting theologically on social issues.(2) This is the establishment of broad theological principles, while at the same time resisting any attempt to make detailed recommendations. In some ways this seems to be a valid

approach since there are relatively few theologians and philosophers who are equipped to understand the detailed knowledge of science that is needed in order to make a realistic contribution to scientific practice. The philosopher Stephen Clark opts for a similar position in his recent book, *How to Think About the Earth*.⁽³⁾ This book achieves its aim to be a serious overview and critique of the larger claims made by preachers, lobbyists and politicians.⁽⁴⁾ The specific ethical dilemmas faced by environmental scientists are not included in his discussion. Ian Barbour's latest volume *Ethics in an Age of Technology* outlines the basic science of genetic engineering.⁽⁵⁾ However, the philosophical and theological implications are more generally related to technology, rather than the specific issues associated with genetic engineering. My purpose here is to look at three different attitudes to genetic engineering that are most common, using particular case studies as illustrations. I will then offer a philosophical critique in the light of real decisions faced by both policy makers and scientists. Finally, I will indicate ways in which theological reflection can contribute to the ongoing discussion. My method, then, is 'from below', drawing on particular examples which are environmentally significant as a basis for reflection. This mirrors, in part, my own experience of biologist first, followed by theologian. To some extent I am assuming at the outset certain theological principles as given, such as the belief in the goodness of God as Creator and the idea of humankind made in the image of God.⁽⁶⁾

GENETIC ENGINEERING AS PROMISE

The green revolution is the cultural and scientific soil out of which grew an optimistic attitude to genetic engineering as applied to agriculture. In the late 1960s traditional plant breeding methods were used by scientists to develop high-yield seeds. When this was combined with more intensive use of fertilizer there were vast increases in production,

especially in Third World countries. In India, for example, the wheat crop was doubled in six years.(7) However, the dream that the green revolution could solve the world food crisis came up against unexpected difficulties. Small farmers and the rural communities were ousted by wealthier landowners who could afford the costly fertilizers. In addition, the mechanized form of farming reduced the need for human labour and thus, ironically, increased overall poverty and deprivation. While India has now become a food exporter, the poor still cannot afford the food they need for survival.(8)

More recently there has been a drive for the development of crops which require less fertilizers as well as the introduction of appropriate technology that requires less fuel.(9) Much of the task of genetic engineering has been no more than to complement that of traditional breeding methods. However, instead of taking several years to develop a new crop, it now takes a matter of months. In this respect genetic engineering could be seen as a liberation from time constraints imposed by slow growing crops. In a hungry world few would wish to legislate against the development of crops that could flourish in the poorer areas of the world hampered by dry, salty or nutritionally poor conditions. However, while the green revolution was directed towards the needs of the Third World, genetic engineering is more often conducted in the West under industrial contracts requiring patents for new varieties.(10) The promise of genetic engineering seems, then, to be directed towards the needs of high income populations such as prescription drugs, or crops grown for the Western market, where the profits are high.

GENETIC ENGINEERING AS POWER

A specific example of the distribution of research to date is that more money has been spent on the development of strawberries that can withstand frost conditions for the spring

USA market than on the improvement of basic subsistence crops, such as cassava, beans, or maize grown in the Third World.(11) Other rapidly expanding technologies include the development of tissue cultures grown in laboratory conditions that have been engineered to produce 'synthetic' products. It may be a matter of time before a biotechnological means is found to produce substitutes for substances such as vanilla or cocoa. If this were to take place we would witness a collapse in the economy of Madagascar, which relies on vanilla bean exports, and the economy of West Africa, which relies on cocoa. Biotechnology is becoming a means of oppressing Third World economies and seems to drive a deeper wedge between rich and poor nations. It is these long term *social* consequences of genetic engineering which need careful consideration. While there is legislation in place, at least in principle, to protect the environment from the possible health risks of genetic engineering, it becomes much harder to legislate towards research priorities. The market economy seems too crude an instrument to act in a way which protects the interests of all concerned. The promise of genetic engineering is becoming, instead, a means for making profit in a way that allows further domination of the poorer Southern nations by the richer Northern ones.

There is another sense in which genetic engineering can be seen as a power, and that is human power and domination of the natural world. It is now possible, for example, to engineer genetically bovine growth hormone (BST) in laboratory conditions. If this is injected into cows this increases the production of milk by 15/20%. The idea that cows and other farm animals can be manipulated in this way for human benefit alone encourages human perception of animals as resources to be managed.(12) Other even more insidious developments include research into production of animals that can withstand their overcrowded conditions. Although conventional breeding is used in this case to achieve

this aim, it may be a matter of time before it could be achieved using genetic engineering. In this case it represents the *loss* of a particular capacity, which is easier to achieve by genetic engineering compared with the *addition* of a positive attribute. This is related to the fact that deletion of sections of genetic material is easier than unravelling the regulation of a complex battery of genes that are required for certain character attributes. In most cases such deletion is likely to be lethal and thus unusable or produce other unwanted side-effects. However, the attempt to direct research in this direction exemplifies the bland assumption that the animal is little more than a mechanism. The aim is to produce an animal that is a passive 'vegetable' in intensive conditions, which amounts to loss in quality of life.

GENETIC ENGINEERING AS THREAT

The genetic engineering of animals in the manner described above could be seen as a potential threat to animal welfare for the sake of human interests. However, the fear of genetic engineering in the public mind is usually associated with a perception of either the risk of genetic engineering *per se*, or the threat to authentic human existence.

The environment risk factors associated with genetic engineering are related to the power of the technology to bring about irreversible change in the hereditary material of plants and animals. For example, it is now possible to engineer genetically crop plants that are resistant to chemical herbicides. Recently, a government advisory committee has given a Belgian company permission to release a genetically engineered rapeseed that contains resistance to the herbicide 'Basta'.⁽¹³⁾ This, in theory, allows farmers to control weeds in rapeseed fields that are normally also susceptible to the herbicide. There were no public consultations prior to the decision by the committee. In this case the risk factors will be

enhanced because the environmental consequences will not be monitored adequately by a company determined to market the product. The company denies that there is any risk to the environment. However, while there have been over sixty small-scale releases of genetically engineered organisms in Britain, there has only been one scientific study of the environmental consequences. It is *not proven* that this new rapeseed will be benign in an environmental sense. If anything, the science suggests the opposite since rapeseed can cross-fertilize with wild mustard plants and even become a weed in roadside verges. Once these genetically engineered plants are established they would be difficult to control as they would be herbicide resistant.

There are other more indirect risks in this instance. The very development of herbicide-resistant crop plants encourages herbicide use, which is in itself a threat to the natural ecosystem. Government regulations rarely consider indirect risks of this type. Furthermore, the increased dependence of the farmers on herbicides for weed control encourages an equal dependence on the hybrid seed sold by the same company as a package. Hybrid seeds do not breed true in the next generation, which means that for a uniform crop the farmer relies on new seed purchased every year, instead of more traditional methods of saving seed from the crop the year before.(14)

Another indirect risk, which is also characteristic of conventional plant breeding, is the overall reduction in genetic diversity. However, in the case of genetically engineered plants this uniformity can be transferred to other species as well through transgenic manipulations, that is, genetic transfer to another species. A Dutch company is presently testing the herbicide resistance system developed originally for rapeseed, discussed above, for chicory plants. Crops which grow from wild strains have a much greater

variability which protects them from pests and disease. When a crop is genetically engineered the resultant uniformity brings the desired increase in yield, but also carries a greater risk of vulnerability to disease. Much of the classic plant breeding was directed towards keeping 'one step ahead' of the rapidly changing populations of virulent fungi and other pests. While the genetic engineering of plants can speed up this search for resistant crops, it eventually leads to a loss of variability available for potential change. This loss of natural variability within one species is irreversible. In order to find sources of variation researchers have sought wild strains which have retained their genetic variability and which still grow in poorer Southern continents. The need for foreign investments means that in many cases the patent for these seeds does not reflect the potential benefit for Northern markets.(15) The threat of genetic engineering in this case has become another occasion for the abuse of power.

There are other examples which show how biotechnology can become a threat to genuine human existence. The traditional close relationship between the farmer and his land seems to be replaced by a transference of power to seed companies, as exemplified by the following. In 1992 a biotechnology subsidiary of WR Grace (USA), called Agracetus, was given the patent on all genetically engineered cotton plants.(16) The patent covers any genetically engineered cotton species, which gives the company a monopoly on all newly developed strains. Agracetus can charge royalties to any company or scientist intending to engineer cotton genetically. Farmers also have to pay royalties if they grow these plants selected for high yields. In effect the company has a monopoly on cotton growing. Even the biotechnology industry regarded this as an unfortunate anomaly. Yet the European patent office has recently repeated this mistake in giving Agracetus a patent on all genetically engineered soya plants. Those most likely to suffer are the Third World

farmers who cannot afford to pay the licence fees. The Rural Advancement Fund (International) helps countries in the Third World to monitor developments in biotechnology. It has declared its intention to challenge the soya patent through legal means.

The potential threat of genetic engineering seems to have been anticipated by Pope John Paul II, who said in an address to UNESCO:

The Future of man and mankind is threatened, radically threatened, in spite of very noble intentions, by men of science ... their discoveries have been and continue to be exploited - to the prejudice of ethical imperatives - to ends of destruction and death to a degree never before attained, causing unimaginable ravages ... This can be verified as well in the realm of genetic manipulations and biological experiments as well as in those of chemical, bacteriological or nuclear armaments.(17)

While his direct accusation of scientists *alone* seems a little misplaced, it is true that the potential abuse of the power of genetic engineering represents an enormous threat to human survival and quality of life. Adequate restraints and controls cannot, therefore, be left purely to government commissions.

A PHILOSOPHICAL CRITIQUE

The French philosopher and social critic Jacques Ellul describes technology as an autonomous and uncontrollable force which pervades social, economic and political life.(18) This leads to an enslavement to all that the technology demands. If we extend this idea to genetic engineering then the very fabric of life becomes subject to a form of determinism. At the opposite extreme, it is possible to portray technology as a liberator, a product of human choices. Samuel Florman is an engineer who argues that the life of earlier centuries has been over-romanticized.(19) He believes that the undesirable effects

of technology can be overcome by more technology. One example of this would be the use of genetic engineering to overcome the problem of crop sensitivity to herbicides.

The extent to which we perceive genetic engineering as a threat or a promise reflects a wider human dualism in our own perceptions. On the one hand we are actively involved in our individual schemes and projects, while on the other hand we can stand apart from these and adopt a more holistic perspective.⁽²⁰⁾ The beneficial effects of genetic engineering in the development of new medicines and the protection of animals and plants and in some cases humans against disease is often cited by genetic engineers to justify their work and achievements. This view is unashamedly anthropocentric in putting human interests first and using genetic engineering as a means for perceived human advancement. On the other hand, the wider impacts of some of these developments and the very idea of interfering with hereditary material in an irreversible way gives rise to a genuine concern that genetic engineering is to the detriment of life and the planet as a whole.⁽²¹⁾ Those who insist that the interests of all life forms are to be given moral worth are often called 'biocentric'.⁽²²⁾ This is related to current scientific method. A reductionist methodology in science analyses the separate components as a way of understanding life. Genetic engineering is necessarily the fruit of this reductionist approach. An alternative is to examine the totality of interrelationships and ecosystems, which leads to a form of holism. This radically different approach even within the biological sciences leads to conflict between genetic engineers and ecologists as to the goals of their research. It seems to me that this mirrors the ambiguity felt by the wider public in relation to the value of genetic engineering.

It might be possible to argue against any genetic engineering as being somehow

unnatural. However, it is important here to distinguish between the use of genetic engineering to speed up what would be possible by normal breeding methods and its use in transgenic experiments. There are those who object to genetic engineering on the basis that it is an invasion of biological integrity. However, according to biologists' understanding of evolution, biological integrity as such does not exist. As a consequence we share many of the same biological and physiological processes as other life forms. Furthermore, the ability of breeders and farmers to bring about change over a relatively short time span became part of the evidence for Charles Darwin's theory of evolution.(23) It seems questionable whether natural selection is any more altruistic *for the species* than artificial breeding or genetic engineering. It seems to me that the philosophical basis for regulation and constraints in genetic engineering needs to be sought in avenues *other than* a vague notion of biological integrity. I will return to this point again below.

In all breeding methods there is a tendency to treat animals and plants as commodities. Genetic engineering allows, then, an even greater detachment from the animal or plant in such a way that they can become highly vulnerable to exploitation. Heidegger rejects the idea that technology is neutral and is simply a means to an end.(24) He suggests that modern technology has failed to bring forth what is the original intention of the natural environment. Instead technology is confrontational and challenging. As such this is an unreasonable demand placed on nature. Heidegger argues that this attitude in technology was prior to the modern physics of the seventeenth century - and, I would add, prior to the modern biology of the twentieth and twenty-first centuries. He believes that the greatest illusion for humans is to see everything as their own construction, since it drives out other forms of revealing from within the natural world. Heidegger did not totally reject technology, but was actually aware of its ambiguities for a genuine human existence. The

same could be said for the biotechnology revolution of contemporary Western culture.

Paul Taylor has suggested that respect for nature is a key paradigm in the development of a theory of environmental ethics.(25) By 'nature' he seems to mean the human as well as the non-human species, so his theory could be translated into the idea of the respect for life. In this way we are all part of a simple biotic community, a theme taken up and developed by other philosophers such as Baird Callicott.(26) The key question is whether the recognition of a relationship of mutual dependence constitutes a *moral* relationship as well. Robin Attfield argues against the idea that interdependence strengthens moral relationships, preferring the notion that all species who have interests *have moral standing*.(27) We could ask: What does it mean for a species to have interests? This seems to be related to the idea of what constitutes respect. Kant believed that if we treat people as a means to our own ends and do not recognize their ends, we are failing to show respect.(28) Genetic engineering has to treat living things in a mechanistic way in order to achieve its goals. However, there is a distinction between treating living things purely as a means for our ends, disregarding that creature's ends, and bringing our interests in line with that of the creature. This echoes the idea of Heidegger that we become sensitive to the revealing within the natural world. However, it still requires *human* judgement and a form of empathy to decide exactly what the interests of the creature mean in practice. There seems to be no need, then, to reject genetic engineering in principle, as long as we take into account the interests of the creatures concerned. In the case studies cited above the deliberate manipulation of animal hereditary material as a means of rendering the animal more passive in crowded conditions seems an unacceptable violation of that creature's interests.

It seems to me that while the idea of respect for life and the interests of creatures as a philosophical basis for ethics can take us some way towards working out priorities in genetic engineering, if we focus just on the immediate interests of the creature we can all too easily fail to look at the wider social and environmental consequences. I would also add that we need to take into account the long-term interests of the environment as a whole as well as the interests of the whole human community. For example, if we take the case of herbicide resistance introduced by genetic engineering there seems to be no evidence that this causes immediate harm to the species involved. If anything, the crop will benefit by carrying genes for herbicide resistance, as it survives in the presence of this chemical. None the less, as I showed above, the potential effects on the ecosystem and the farming community could be catastrophic. In this case the interest in profit seems to be higher than the respect for the wider community. Holmes Rolston III has argued for the idea of 'systemic value' as a way of taking into account the worth of the whole ecosystem.⁽²⁹⁾ This could possibly be a useful concept as applied in the case mentioned above. However, the idea needs some qualification as it can lead to an over-romanticized view of the biological integrity of the whole system, a point I alluded to above. The actual biological stability of ecosystems is a highly debatable topic in ecology. Ecosystems emerge in a more random way than is implied by some 'deep green' philosophers. Having said this, there is no guarantee that the new ecosystem that would develop after human interference would be either desirable or controllable. I will return to this point again below. It is ironical, perhaps, that genetic engineering, which seeks to assert human power over the natural environment, can lead to situations which could, potentially, be uncontrollable. The Utopian vision of a custom-made world is supposed to lead to a fully controlled environment for human habitation. Charges of sentimentality abound, both against genetic engineers who have such a vision, and, in return, against the animal liberationists. A

pioneer in the latter group is Tom Regan who believes that the aims of animal rights activists should be towards the abolition of commercial agriculture and the use of animals in science.(30) This would, in effect, amount to a moratorium on genetic engineering, at least as applied to animals.

The philosopher A.A. Brennan has argued that one of the main problems in making decisions about environmental problems is our lack of honesty: 'It is neither unfair nor unkind to governments, public agencies and corporations to observe that we are a long way from full honesty in our debates and deliberations on the environment.'(31) He insists that this dishonesty is encouraged by the public acceptance of a shallow analysis of science and mythic portrayals of our situation, both of which encourage 'self-deception' and 'incontinence'. The first myth he highlights is that of restoring nature, after human interventions such as mining, industrialization, etc. There is a strong belief that, given the right technology, we can restore nature to the original condition. I could add here the myth of *improving* nature as applied to genetic engineering. A good example would be the attempt by scientists, so far unsuccessful, to transfer nitrogen-fixing genes from legumes, such as clover and peas, to cereal plants such as wheat. Such a transgenic experiment promises to *improve* nature by giving wheat plants the potential to fix gaseous nitrogen so that they would be less dependent on artificial fertilizers.(32)

In the 'natural' state legumes fix nitrogen by relying on a bacterium which occupies its host plant in special swollen parts of the roots called nodules. Although the project sounds altruistic and environmentally friendly, the dishonesty lies in a failure to point out physiological and ecological features. Firstly, even legumes rely on artificial fertilizers to increase yields, so that it is by no means certain that such manipulation would reduce

fertilizer use sufficiently to reduce environmental damage. More important perhaps, secondly, the technique involves modifying the bacterium/host relationship in such a way that the bacterium is no longer host specific. There seems to be no guarantee that such a relationship would be stable in field conditions, raising the spectre of the release of modified bacteria into the environment. The dishonesty lies in a failure to recognize that the project is not as environmentally friendly as it appears. More often such projects are given an environmental gloss as a way of appropriating funds for the patent on the modified seeds, or, more simply, as a way of enhancing the publication record of an institution as a means of gaining greater power and influence in a particular area of research.

Brennan also asks the question as to whether the restoration of the natural environment after industrialization would give the Northern continents more authority in demanding that Southern countries preserve their tropical rainforests. However, it is biologically naïve to assume even in the forests of the North that any real restoration to the original diversity is possible. In the tropics the rate of elimination of species is so high that all talk of future restoration is wishful thinking. Yet genetic engineers, predominantly in richer Northern nations, are relying on the Third World as a reserve for potential genetic variability.

Another common myth is that of 'wild' nature. Holmes Rolston III has used this idea as a paradigm for his philosophy of environmental ethics.⁽³³⁾ Attached to this myth is the idea that all 'wild' ecosystems are both stable and diverse. While the characteristic of biodiversity is true for the tropical rainforest, it is not true for all other ecosystems. For example, Horn has shown that in the New England woodland the sequence of succession is towards a reduction of biodiversity. Periodic fires and the impact of humans serve to

maintain the existing biodiversity.(34) I am not saying that the preservation of biodiversity is mistaken; rather, it cannot be supported by reference to 'wild' nature. I would also agree with Brennan when he points out that 'It is striking, and unfortunate, that many conservationists still operate with ideas of balance and diversity in nature that were more prevalent in the nineteenth century than among contemporary ecologists.'(35)

The myth of balance and biodiversity is important for 'deep green' philosophers as it seems to provide a biological basis for non-interference. However, absolute non-interference is not really an option for humans, any more than any other species. It is the form of meddling that raises moral, aesthetic and policy issues. Furthermore, the biodiversity of species mentioned in this context needs to be carefully distinguished from the natural variability in a given species that I mentioned above in relation to the classical plant breeding and the genetic engineering of cereals. This natural variability is an in-built mechanism for protection against disease. Once it is lost, the uniform nature of the crop means that susceptibility to disease is equally uniform and spreads through the whole crop. A further qualification to Brennan's thesis is that the drastic loss of species caused by human interference in the tropical rainforests cannot be desirable. However, he is right in his belief that the basis for the maintenance of such diversity cannot be sought in forms of 'naturalism' which exalt a view of 'nature' which is out of touch with modern ecology. The protection of the interests of the species seems a more fruitful approach as long as it is set in the context of the interests of global ecology and issues of justice related to the human community. There are other arguments which could be brought to bear which overlap with theological perspectives, outlined below.

To conclude this section: there seems to be no real philosophical basis for complete

abstinence towards genetic engineering as applied to agriculture. Rather, following Heidegger, it seems to me that we need to work towards the transformation of genetic engineering so that it comes to represent a more fully humane enterprise, in touch with the immediate and long-term effects.(36)

THEOLOGICAL CRITIQUE

William Frankena, in his analysis of the potential of theology for ethics, argues that while theology does have an 'ethic', it cannot answer all questions by itself.(37) The problems of interpretation and application still leave difficult decisions which cannot be answered by theology alone. The normative elements in biblical theology, such as the ten commandments, may be a guide for living, but this is different from morality as such. For example, the sabbath day commandment is less a moral question than one of lifestyle. A more relevant contribution of theology perhaps, in the present context, is the way a theological perspective influences ethics. Frankena argues that logically ethics need not rest on theological presuppositions. However, the latter does show us what areas are particularly important to consider in ethics and provides both a rationality and motivation for ethics. Frankena's position is intermediate between those who would argue that theology is impotent for ethics, in other words that ethics is autonomous, and those who use theology as a basis and foundation for ethics.

The concept of autonomy in ethics seems to foster a broadly Kantian version of the division of labour for ethical decision making, where ethics becomes a disembodied autonomous subject legislating for itself on the basis of disengaged reason alone.(38) There is a tendency for this model to collapse into the idea that science alone can solve all environmental problems, since ethical value becomes objectified and unambiguous. An

example, in practice, of the way science has attempted to introduce a notion of value as part of its directives is the practice of cost-benefit and risk-benefit analysis. In this case the sum preferences of all individuals affected by a decision are taken into account in arriving at 'ethical' judgements.(39) The question remains: how ethical are such practices?

It seems to me that any claim of autonomy on the part of ethics is naïve in its failure to recognize the complex cultural context, which includes a religious perspective.

Furthermore, such an approach assumes, incorrectly, that all ethics would necessarily come to a univocal position in a way which ignores the concrete realities of ethical dilemmas. For McCormick the biblical story of faith becomes the 'overarching foundation and criterion for morality'.(40) A Christian speaks out of the experience of this story, so that reasoning in ethics is informed by faith, and theology 'yields a value-judgement and a general framework or attitude. It provides a framework for subsequent moral reasoning'.(41) McCormick insists that we truncate the task of theology if we see it as an action guide, rather than looking at wider issues such as the quality (good/bad) of the agent. This does not mean that all morally relevant insights are specifically Christian; rather, a Christian perspective confirms and critiques ethical practice.

For theology to be true to its task it must include a reference to an ultimate power.(42)

Gustafson describes this approach as theocentric ethics.(43) Religion is very often used for its utility in sustaining moral causes and purposes for which the deity becomes incidental. This is similar to the idea that values are incorporated into policy-making as a means to encourage particular social action. The rationale for this move is that the bare facts alone have failed to influence public opinion, so values, including religious ones, are introduced as a way of encouraging particular forms of behaviour.(44) The goals, then, are

set prior to any consideration of theology or ethics and values are introduced so as to act as a 'social lubricant'. This form of social engineering represents an unacceptable use of the relationship between theology and ethics. As applied to genetic engineering it would imply that the goals are decided already and religious values which cohere with such goals are then promoted.

If we take as a starting-point the critical social issues of the time, there is a temptation to put religion to the immediate needs of groups, societies and individuals. In this sense God becomes an instrument in the service of human beings. This is not the intention of this article. Rather, by beginning with some of the issues associated with genetic engineering in agriculture, the theological discussion becomes more rooted in concrete reality. The opposite danger, namely a theological discussion that never moves further than rarefied concepts of God, seems to me to be more prevalent amongst contemporary theologies of creation. The failure of science alone to come up with any effective answers to complex environmental issues is occasion enough to widen the debate to include other disciplines. This is especially true as applied to biotechnology where it is still possible for theologians, philosophers and ethicists to contribute to the shape of this rapidly expanding science.

The question now is, how can the language about God help to shape the ethical directives in genetic engineering? For some religious believers the very idea of genetic engineering sounds like blasphemy. What right have humans to interfere with the natural world when it has been declared by God to be good? In answer to this question I refer to the above discussion about the interference of humans in 'wild' nature through cultivation of the land since the dawn of human existence. The questions are: What kind of interference is justified, given a belief in the goodness of creation? and What are the social and

environmental consequences? The current discussion about the morality of genetic engineering has focused almost exclusively on medical ethics and the human genome. Lehmann, for example, argues that we should suspend genetic engineering because it goes against the idea that 'knowledge of life processes must be used to reinforce what is human in us'.(45) In other words, genetic engineering is somehow dehumanizing. According to biblical anthropology human beings are made in the 'image of God', so to interfere with human genetic material might seem to go against the special position of humans as made in the divine image.

How far can we extend this idea of the divine image in order to apply a moratorium on the genetic engineering of animals and plants? The theological paradigm that seems relevant here is the experience of the Judaeo-Christian community of a God of love. The command of God in Genesis for humans to exercise dominion over creation is qualified by the essence of the relationship between Creator and creation as one of loving involvement. Creation becomes an expression of the love and glory of God. As Moltmann points out:

The world as a free creation cannot be a necessary unfolding of God, nor an emanation of his being from divine fullness. When he creates something that is not God but also not nothing, this must have its ground not in itself, but in God's will or pleasure. It is the realm in which God displays his glory.(46)

The new creation is one where God will be 'all in all'. The world becomes transfigured by the presence of God through the participation of creation in God's infinite creativity.(47) This echoes the Eastern Orthodox concept of participation of creation in the *energeia* of God.(48) Karl Rahner, similarly, insists that it is God's intention to give creation a supernatural end, which has an effect on the essence of being itself.(49) For Rahner, the natural knowledge of God as perceived in creation is not sharply distinguished from the

revelation of God. However, the Christological dimension in Rahner's thought qualifies the theme of the future glory of creation. Moltmann, similarly, insists that the cross of Christ reminds us that the future of creation is not utopia on earth.

Given this theological perspective which stresses the love of God and the future glory of all creation, how does this affect environmental ethics? First the cross of Christ reminds us both of the reality of the suffering of creation and of the very real temptation for humans to sin in identifying their enterprise with absolute value. Genetic engineering can never achieve utopia on earth, especially when blind to its use as an instrument in suffering. Moreover, God's love for all creation demands a respect for the interests of all creatures, whether they are produced by breeding methods or genetic engineering. This applies, as well, in making policy decisions as to the direction of research. Human beings, as made in the image of God, share in the creativity of the Creator. The Creator's intention is towards future glorification. Hence, the human motivation to develop new varieties and transgenic species needs to come under careful scrutiny. The possibility of dishonesty in the use of environmental language to cover up consumerist interests has to be exposed. Here environmental ethics overlaps with business ethics and social conduct.

The latter raises questions about human justice. For some years questions to do with the environment were considered in a way that was detached from development issues.⁽⁵⁰⁾ Development workers tended to despise environmentalists as those who seemed to pay more attention to the survival of animals, rather than people. More recently, there has been a greater appreciation of the interrelationship between environmental problems and development issues. It seems to me that this linkage is of special relevance to the particular questions surrounding genetic engineering, as highlighted in the case studies

given above. A Christian theological perspective would insist on examining the long-term consequences to poorer nations and communities.(51) It is this broader view which it is essential to keep in mind when dealing with decisions about the validity of particular genetic engineering projects. The wider global environmental impact also has to become part of the consideration by those given the power to implement policies. Hence it is both a question of what is good for humanity as well as what is good for the whole natural world. In this way the wider human and cosmic contexts act as points of reference.(52)

A theological critique requires a radical change of attitude in formulating the goals of genetic engineering from one based on consumerism and the individual pursuit of happiness to a more community based view which includes respect for the whole environment. This respect is understood in terms of knowledge of the Creator who created the world out of nothing. Some theologians have attached the idea of respect for the environment to the concept of *Gaia*. The scientific hypothesis of James Lovelock encourages us to understand the planet as a living system. It has echoes in the ancient mythology of *Gaia*, the Earth Goddess. As I have argued elsewhere, basing an environmental philosophy on Lovelock's *Gaia* hypothesis has its own particular pitfalls scientifically, theologically and ethically.(53)

For some theologians even the idea of genetic engineering represents an unacceptable expression of human power and domination over creation. Linzey, for example, believes that 'Genetic engineering represents the concretization of the absolute claim that animals belong to and exist for us ... *they become totally and completely human property*'.(54) He describes genetic engineering as a form of animal slavery. The idea that animals and plants are made simply for human use has its roots in the teaching of Aristotle.(55) A

similar view is echoed by Aquinas who insisted that non-human creation was for the benefit of humans.(56) He distinguishes between the general care of animals and love and fellowship amongst the human community.(57) The idea of cosmic fellowship and friendship with the whole creation has become a popular motif amongst contemporary theologians concerned with the environment.(58) While I would argue against Aquinas's notion that all creation exists purely for human benefit, there seems to be some validity in the idea of *distinguishing* the love among humans from the love of humans for the cosmic community. If we deny that there are any distinctions we end up with a total moratorium on all genetic engineering, and probably many forms of traditional agriculture.(59)

It would be inappropriate to lay the blame for the abuse of genetic engineering on only the scientists involved. We are all implicated in the social web of which scientists are a part. In seeking for a change in attitude amongst those more directly involved, a wider *metanoia* is needed which incorporates a sensitivity to creation in every aspect of our lives. This *metanoia* includes an attitude of humility and respect for all members of the human community. The very survival of the natural world requires sacrificial effort on our part. In the words of the Ecumenical Patriarchate:

This is a new situation, a new challenge. It calls for humanity to bear some of the pain of creation as well as to enjoy and celebrate it. It calls first and foremost for repentance, but of an order not previously understood by many.(60)

If we love creation we begin, then, to see the 'divine mystery in things'. This awareness of the sacred in creation can become the lens through which we seek out what our responsibilities are in caring for the earth. The most common mind-set amongst genetic engineers is to fix on a particular problem or goal and to find ways of attaining this goal. A theological approach encourages those involved to see the wider social and religious

consequences of these decisions. It does not necessarily ban all genetic engineering, but seeks to transform it so that it more clearly represents a fully human enterprise.

Philip Sherrard's book *Human Image: World Image* is important in its reinstatement of the idea of creation as sacred.(61) However, he is far too harsh in his treatment of modern science and scientists. He believes that any attempt to interfere with or remodel creation amounts to 'sheer folly', treating scientists as scapegoats, especially the mathematicians. Such a move is not particularly helpful. It seems to me that understanding the world as in some sense sacred is compatible with modern science as long as it seeks ethical ways forward. A complete retreat from science is a refusal to face the realities of this world of which we are part. Sherrard's rejection of all dualistic thinking, which he describes as a 'form of depravity' seems to extend to his understanding of the relationship between God and the world. As we might expect, he rejects the concept of the creation of the world out of nothing, and in so doing he blurs the distinction between God and creation.

The *ethical* consequences of a fully fledged antidualism are somewhat disturbing. Szerszynski has summed up the arguments against antidualism.(62) One of his most important insights is that a refusal to distinguish adequately between ourselves and creation leads to an identification with the earth, which leads to a form of narcissism. For Matthew Fox and others, sin becomes treating others as separate from ourselves.(63) Instead of a genuinely relational ethic we arrive at an incorporation of the other into ourselves. Szerszynski points to the increasing tendency to turn to the non-European traditions for a saving role in ecology 'as if they were the repressed contents of the European unconscious'. However, there seems to be no link between cosmologies and potential damage to the natural environment.(64) Szerszynski also argues that the idea of

environmental concern is bound up with an objectification of non-human creation as other than ourselves. John Milbank argues that the objectification of nature is still part of much 'green' theology, so that any attempt to re-sacralize nature is misplaced.(65) However, it all depends on what we mean by the sacred in nature. A true understanding of the sacred respects the difference in the other. It seems to me that we can affirm the idea of the sacred without rejecting all distinctions. Like the Celtic saints, a keen awareness of the transcendence of God is matched by an appreciation of God's immanence in creation.(66)

Hans Küng's *Global Responsibility* is a brave attempt to locate world religions in the field of ethics.(67) However, his suggestion that a single world ethic can emerge from many different religious perspectives seems to me to be misplaced. It would tend to deny the distinctive contribution of each culture. There is also disappointingly little reference in his work to the global problems of ecology.(68) While the dialogue between different faiths is important in contributing to the practical task of policy making in genetic engineering, each faith needs to become aware of its own distinctive contribution. A lowest common denominator approach is unlikely to yield the promised fruit and more likely to raise false hopes.

CONCLUSIONS

The revolutionary changes taking place within biological science, in particular genetic engineering, has encouraged a mixed sense of awe and threat. Lewontin has suggested that the power of DNA technology is such as to give biology the status of 'ideology'.(69) I have argued in this paper that it is the application of genetic engineering in biotechnology that raises significant philosophical, ethical and theological questions. The awe at the dawn of the new technology is tempered by the knowledge of the potential of

biotechnology to be abused as a means of power and domination. While on the one hand the technology promises solutions to immediate technological and scientific problems, on the other hand the indirect effects of such technology can easily be overlooked by policy makers interested only in immediate short-term damage limitation. A philosophical perspective can offer a more holistic approach. However, the language used by philosophers can be out of touch with modern developments in biology. Various myths such as the goodness of 'wild nature' or its 'integrity' abound. A real transformation of genetic engineering which would allow it to become a more fully humane enterprise is rarely discussed. A theological approach offers a spiritual dimension to the discussion and asks, in particular, how these changes impinge on those who are part of the Christian story. It challenges the injustices raised in the human community as well as the more indirect damage to the natural environment. However, if theology concentrates on the idea of the sacred in 'nature' to the exclusion of the transcendence of God, we reach an impasse. It seems that science and genetic engineering *per se* become impossible. Furthermore, it encourages an unrealistic retreat into the spiritual sphere, which is out of touch with modern biology and science. This is the very opposite of the claim to be 'holistic'. It seems to me that a more traditional understanding of God as transcendent yet immanent in creation provides a way through the current vogue of 'naturalism' into a more realistic and fruitful dialogue with science.

Notes

1 See, for example, M. Midgely, *The Ethical Primate: Humans, Freedom and Morality* (London: Routledge, 1994); World Council of Churches, *Manipulating Life: Ethical Issues in Genetic Engineering* (Geneva: WCC, 1982); J. Mahoney, *Bioethics and Belief* (London: Sheed and Ward, 1984); A.C. Varga, *The Main Issues in Bioethics* (Revised edition, Dublin: Paulist Press, 1984); J. Harris, *Wonderwoman and Superman: The Ethics of Human Biotechnology (WS)* (Oxford: Oxford University Press, 1994); D. Suzuki and P. Knudtson, *Genethics: The Ethics of Engineering Life (GE)* (London: Unwin Hyman, 1990). GE outlines the basic techniques of genetic engineering for the non-specialist. Biotechnology is usually understood to mean the application of biology in commercial

ways, which includes agricultural practice, though the term biotechnology usually implies genetic engineering when used in ethical discussion.

2 W. Temple, *Christianity and Social Order* (London: Penguin, 1942).

3 S. Clark, *How to Think About the Earth* (London: Mowbray, 1993). For a review, see C. Deane-Drummond, *Third Way* 17 (6) (1994), p. 26.

4 Clark, *How to Think About the Earth*, p. vii.

5 I. Barbour, *Ethics in an Age of Technology (EAT)* (London: SCM, 1992).

6 For a more general discussion of the relationship between biology and theology, see, C. Deane-Drummond, 'Biology and Theology in Conversation: Reflections on Ecological Theology', *New Blackfriars* 74 (1993), pp. 465-73.

7 S. Wortmann and R. Cummings, *To Feed the World* (Baltimore: Johns Hopkins University Press, 1978).

8 M. Lipton and R. Longhurst, *New Seeds and Poor People* (Baltimore: John Hopkins University Press, 1989). There are, of course, many other factors which contribute to malnutrition in the Third World, such as an overconcentration on export crops instead of food crops. In this case the balance of trade favours the consumers. A detailed discussion of trade deficits and other general factors such as overpopulation is outside the scope of this article.

9 E.C. Wolf, *Reversing Africa's Decline* (Washington: World Watch Institute, 1985); E.C. Wolf, *Beyond the Green Revolution: New Approaches to Third World Agriculture* (Washington: World Watch Institute, 1986).

10 The perceived novelty of genetic engineering techniques and the organisms they produce has allowed researchers to patent *living* organisms, their parts or processes. The first patent was given in 1980 by the Supreme Court in USA for a genetically modified bacterium. Patenting has accelerated the trend towards monopolies in seed production by one or two large companies which 'reduces both genetic diversity and economic competition', Barbour, *EAT*, pp. 191-2. See also, P. Wheale and R. McNally, *Genetic Engineering: Catastrophe or Utopia (GECU)* (New York: St Martin's Press, 1988); P. Wheale and R. McNally (eds.), *The Bio-Revolution (BR)* (London: Pluto, 1990).

11 Frost resistance in strawberries is achieved by genetic engineering of a bacterium that normally lives on the surface of the strawberries and acts as a nucleation site for ice crystals. See, K. Dahlberg, *New Directions for Agriculture and Agricultural Research* (Lanham: Rowman and Allanheld, 1986).

12 For a series of articles on bovine growth hormone (BGH), otherwise known as bovine somatotropin (BST), see Wheale and McNally (eds.), *BR*, pp. 57-100. See also Barbour, *EAT*, pp. 192-4. There is considerable controversy over the exact nature of BST, that is, whether it is identical to the hormone produced naturally. There are also arguments about the potential stressful effects on cows, which has attracted considerable attention from those concerned with animal welfare. The question now is whether the use of BST is encouraging an attitude which treats cows as if they were a 'biomachine'. Moreover, the use of BST is confined to large farms, which puts the smaller farmers at a disadvantage. It is also a potential risk to human health as its long-term effects have not been properly investigated. Overall it is an ironical development, given the overproduction of milk and surpluses of dairy products. For a comment on the breeding of animals to 'withstand their conditions', see, A. Holland. 'The Biotic Community: A Philosophical Critique of Genetic Engineering' in Wheale and McNally (eds.), *BR*, pp. 171-2.

13 A new bimonthly newsletter has been launched this year called *GenEthics News*, edited by D. King, which deals with up-to-date information on the genetic revolution and its ethical and environmental implications. This data is taken from the first issue to be published. 'Government allows unlimited release of genetically engineered plant',

GenEthics News 1 (1994), p. 1.

14 *GenEthics News* 1 (1994), p. 2. Hybrid plants are the result of a cross between two related varieties, so that seeds in the following generation are mixed genetically. This variation will lead to a drop in yield. Only 'pure' strains produce similar seeds, which could also be achieved by cloning, for example. The use of hybrids is a form of in-built biological 'patenting' and it forces farmers to buy new seed each year.

15 See, C. Juma, *The Gene Hunters: Biotechnology and the Scramble for Seeds* (London: Zed Books, 1989).

16 'Patent Offices Hand Cotton and Soya Monopolies to W.R. Grace', *GenEthics News* 1 (1994), p. 3.

17 Cited in G.J.V. Nossal and R.L. Coppel, *Re-Shaping Life: Key Issues in Genetic Engineering* (Second edition, Melbourne: Melbourne University Press, 1989), pp. 132-3. The authors believe that statements such as these just frighten many people and foster disillusionment with science. They retort that it is 'unfair to blame science and technology for the ills in the human condition that are as old as mankind', p. 134.

18 J. Ellul, *The Technological Society*, translated by J. Wilkinson (New York: Knopf, 1964); J. Ellul, *The Technological System*, translated by J. Neugroschel (New York: Continuum, 1980); J. Ellul, *The Technological Bluff*, translated by G. Bromiley (London: Eerdmans, 1990).

19 S. Florman, *Blaming Technology: The Irrational Search for Scapegoats* (New York: St Martin's Press, 1981).

20 For a discussion, see Holland, 'The Biotic Community', *BR*, pp. 166-74.

21 *Ibid.*, pp. 166-74. For an accessible account which includes all aspects of genetic engineering, see Suzuki and Knudtson, *GE*, especially Chapter 12, 'Maize: In Praise of Genetic Diversity', pp. 276-303.

22 Holland does not distinguish between a biocentric view, which extends the idea of intrinsic value from humans to living things, and a holistic view, which gives intrinsic value to the system as a whole. I have summarized the use of these and other terms elsewhere: see C. Deane-Drummond, *Gala and Green Ethics (GGE)* (Nottingham: Grove Books 88, 1993).

23 Wheale and McNally, *GECU*, p. 19.

24 M. Heidegger, *The Question Concerning Technology and Other Essays (QCT)*, translated and introduced by W. Lovitt (London: Harper Torchbooks, 1969), pp. 3-35.

25 P. Taylor, *Respect for Nature: A Theory of Environmental Ethics (RN)* (Princeton: Princeton University Press, 1986), pp. 73ff. Paul Taylor defines *inherent worth* as the worth which is dependent on the valuing subject. All organisms are ideological centres of life, subjects pursuing their own goal in their own way. It is the individual *telos* which gives every individual organism *inherent worth*. The organism becomes valuable in itself, rather than because of its particular state of being. If an entity has *inherent worth* it is worthy of *respect*. If experiences are means to further ends they have *instrumental value*.

26 J. Baird Callicott, 'Elements of an Environmental Ethic: Moral Considerability and the Biotic Community', *Environmental Ethics* 1 (1979), pp. 71-81. Note that a significant distinction between Taylor and Callicott is that Taylor argues for individual inherent worth of all living creatures, whereas Callicott argues for value placed on the collective whole by *human* subjects. For a discussion, see C. Palmer, 'A Bibliographical Essay on Environmental Ethics', *Studies in Christian Ethics* 7 (1) (1994), pp. 68-97.

27 R. Attfield, *The Ethics of Environmental Concern* (Oxford: Blackwell, 1983), pp. 158ff.

28 I. Kant, *Critique of Practical Reason*, London, 1909, p. 47. If we treat a living thing as a means to our ends we give it *instrumental value*. However, following Paul Taylor,

respect is given to a living thing that has inherent worth. For Taylor, an attitude of respect for nature is an ultimate one: 'it is itself the most fundamental kind of moral commitment one can make', Taylor, *RN*, p. 93 and under note 25 above. It is based on a *biocentric* outlook on life, where humans are members of the community of the earth. An alternative, following R. Attfield, is that *moral standing*, which implies respect, is given to a living thing that has the ability to flourish and develop. This ability for flourishing gives the organism interests. While Attfield adopts an individual *consequentialist* position, ascribing value to the *state of being* of a living organism, i.e., their interest in flourishing, Taylor opts for a *deontological* view, ascribing worth to the individual living being in itself, which has its own particular *telos*. Both are focused on the individual, though for Taylor the biotic community is more important. Their views contrast with the collective approaches taken by other philosophers such as Callicott and Holmes Rolston III, discussed below.

29 Holmes Rolston III, *Environmental Ethics: Duties to and Values in the Natural World* (Philadelphia: Temple University Press, 1988). He describes systemic value in the following way, 'This cardinal value, like the history, is not all encapsulated in individuals, it too is smeared out into the system. The value in this system is not just the sum of the part values ... Systemic value is the productive process; its products are intrinsic values woven into instrumental relationships', p. 188; 'Even the most valuable of the parts is of less value than the whole. The objective systemic process is an overriding value, not because it is indifferent to individuals, but because the process is both prior to and productive of individuality', p. 191.

30 T. Regan, 'The Case for Animal Rights' in D. Van de Veer and C. Pierce (eds.), *People, Penguins and Plastic Trees* (London: Wadsworth, 1986), pp. 32-9.

31 A.A. Brennan, 'Environmental Decision Making' in R.J. Berry (ed.), *Environmental Dilemmas: Ethics and Decisions (ED)* (London: Chapman and Hall, 1992), p. 18.

32 For an excellent introductory account on the biology of nitrogen fixation, see J.I. Sprent, *The Biology of Nitrogen Fixing Organisms* (New York: McGraw Hill, 1979). For a more detailed research monograph which includes the genetics of nitrogen fixation, see J.R. Postgate, *The Fundamentals of Nitrogen Fixation* (Cambridge: Cambridge University Press, 1982).

33 Holmes Rolston III, *Philosophy Gone Wild: Environmental Ethics* (Loughton: Prometheus Books, 1989). For Holmes Rolston 'nature' is a source of values and is a 'generative process', p. 121.

34 H.S. Horn. 'Markovian Properties of Forest Succession' in M.L. Cody and J.M. Diamond (eds.), *Ecology and Evolution of Communities* (Harvard University, Cambridge: Belknap Press, 1975), pp. 196-211. While many 'patterns' have been found in communities of species, there is no evidence for fixed relationships which would suggest an 'organismic' model of community ecology. Most ecologists accept the idea of 'limited membership', that is, there are restrictions to the range of species found in any area depending on the physical environment, dispersal of seeds and interactions between species. See J. Roughgarden and J. Diamond, 'Overview: The Role of Species Interactions in Community Ecology' in J. Diamond and T.J. Case (eds.), *Community Ecology* (San Francisco: Harper and Row, 1986).

35 Brennan, *ED*, pp. 16-17.

36 'Within and beyond the looming presence of modern technology there dawns a possibility of a fuller relationship between Man and being and hence between Man and all there is - than there has ever been', Lovitt, from introduction, Heidegger, *QCT*, p. xxxvii.

37 W.K. Frankena, 'The Potential of Theology for Ethics' in E.E. Shelp (ed.), *Theology and Bioethics (TB)* (Dordrecht: D. Reidel Publishing, 1985), pp. 49-64.

38 R. Grove-White and B. Szerszynski, 'Getting Behind Environmental Ethics',

Environmental Values 1 (1992), pp. 285-96.

39 See, for example, D. Pearce, A. Markandya and E.B. Barbier, *Blueprint for a Green Economy* (London: Earthscan, 1989), pp. 56-7.

40 R.A. McCormick, 'Theology and Ethics: Christian Foundations' in Shelp (ed.), *TB*, p. 96.

41 McCormick, 'Theology and Ethics' in Shelp (ed.), *TB*, p. 98.

42 J.M. Gustafson, *The Contribution of Theology to Medical Ethics* (Milwaukee: Marquette University Press, 1975).

43 J.M. Gustafson, *Theology and Ethics (TE)* (Oxford: Blackwell, 1981).

44 Grove-White and Szersynski, 'Getting Behind Environmental Ethics', pp. 289-90.

The authors' citation of ICOREC as an example of the 'social lubricant' model is not really justified by present practice and is an oversimplification of current aims, especially in more recent years.

45 P. Lehmann. 'Responsibility for Life: Bioethics in Theological Perspective' in Shelp (ed.), *TB*, p. 294. Most scholars recognize that there is a difference ethically between genetic modification of the somatic line, that is, cells in the human body, and modification of the germ line, which can be inherited in the next generation. The latter is less acceptable than the former. For a discussion, see Harris, *WS*, pp. 162 ff; Suzuki and Knudtson (ed.), *GE*, pp. 163-91.

46 J. Moltmann, *Theology and Joy*, translated by R. Ulrich (London: SCM, 1973), p.

41. This is an example of Moltmann's understanding of the eschatological direction of creation. I have written a detailed discussion of the development of Moltmann's theology of creation in *Towards a Green Theology through Analysis of the Ecological Motif in Jürgen Moltmann's Doctrine of Creation (TGT)* (PhD Thesis: Manchester University, 1992).

47 J. Moltmann, *Religion, Revolution and the Future*, translated by M.D. Meeks (New York: Charles Scribner's Sons, 1969), p. 34. This theme recurs in subsequent works; for discussion see Deane-Drummond, *TGT*, pp. 286-322.

48 It is the responsibility of humans to act as the link between God and creation, bringing all of creation into communion with God. See, J.D. Zizioulas, 'Preserving God's Creation. Three Lectures on Theology and Ecology. III, *King's Theological Review* 13 (1) (1990), pp. 1-5.

49 K. Rahner, *Theological Investigations, Volume 1*, translated by C. Ernst (London: Darton, Longman and Todd, 1965), pp. 302-17.

50 See, for example, N.J. Faramelli, 'Ecological Responsibility and Economic Justice' in I.G. Barbour (ed.), *Western Man and Environmental Ethics* (Workingham: Addison Wesley, 1973), pp. 188-303.

51 This concern has been voiced forcefully by a number of writers. See, for example, S. McDonagh, *To Care for the Earth* (London: Geoffrey Chapman, 1986); D. Dorr, *The Social Justice Agenda* (Dublin: Gill and Macmillan, 1991).

52 The dominant strand in Western ethics has been that material considerations for morality are derived purely from a human reference point. Alternatives include a cosmic context, which has its secular counterpart in biocentrism. See Gustafson, *TE*, pp. 88ff. and McDonagh, *To Care for the Earth*, pp. 60-95.

53 Deane-Drummond, *GGE*, pp. 9-14.

54 A. Linzey, *Animal Theology (AT)* (London: SCM, 1994), p. 143.

55 Aristotle, *Politics*, 1, VIII, translated by E.A. Sinclair (London: Penguin Books, 1985), p. 79.

56 Thomas Aquinas, *Summa Contra Gentiles*, III, Chapter CXII, reprinted in T. Regan and P. Singer (eds.), *Animal Rights and Human Obligations* (Second edition, New York: Prentice Hall, 1989), p. 56.

- 57 A. Agius, *God's Animals* (London: Catholic Study Circle for Animal Welfare, 1970), pp. 8; 17-8.
- 58 See, for example, J. Moltmann, 'The Cosmic Community: A New Ecological Concept of Reality in Science and Religion', *Ching Feng* 29 (1986), pp. 93-105; S. McFague, *The Body of God* (London: SCM, 1993). It is significant that for McFague sin is a refusal of humanity to live conscious of our relationships with other human beings, animals and the whole of 'nature', i.e., the cosmos, a 'Refusal to accept our place', pp. 112-29.
- 59 This is the logic of extending 'rights' to animals and leads to Linzey describing genetic engineering of animals as 'slavery', where 'Nothing less than the dismantling of this science (i.e. *genetic engineering*) as an institution can satisfy those who advocate moral justice for animals', italics mine, Linzey, *AT*, p. 138.
- 60 The Ecumenical Patriarchate, *Orthodoxy and the Ecological Crisis* (Gland: World Wide Fund for Nature, International, 1990), p. 11.
- 61 P. Sherrard, *Human Image: World Image* (Ipswich: Golgonoosa Press, 1992). For a review, see C. Deane-Drummond, *Theology in Green* 6 (1993), pp. 39-41.
- 62 B. Szerszynski, 'The Metaphysics of Environmental Concern - A Critique of Ecotheological Antidualism', *Studies in Christian Ethics* 6 (2) (1993), pp. 67-78.
- 63 M. Fox, *Original Blessing: A Primer in Creation Spirituality* (Mexico: Bear and Co., 1983), p. 49.
- 64 R.A. Rappaport, *Ecology, Meaning and Religion* (Berkeley: North Atlantic Books, 1979).
- 65 J. Milbank, 'Out of the Greenhouse', *New Blackfriars* 74 (1993), pp. 4-14.
- 66 C. Deane-Drummond, 'Recalling the Dream: Celtic Spirituality and Ecological Consciousness', *Theology in Green* 1 (1993), pp. 32-8.
- 67 H. Küng, *Global Responsibility: In Search of a New World Ethic* (London: SCM, 1990).
- 68 C. Deane-Drummond, 'Review of Hans Küng, *Global Responsibility: In Search of a New World Ethic*', *Theology in Green* 3 (1992), pp. 41-2.
- 69 R.C. Lewontin, *The Doctrine of DNA: Biology as Ideology* (London: Penguin, 1993).