

The Ethics of Terraforming

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I apply an agent-based virtue ethics to issues in environmental philosophy regarding our treatment of complex inorganic systems. I consider the ethics of terraforming: hypothetical planetary engineering on a vast scale which is aimed at producing habitable environments on otherwise “hostile” planets. I argue that the undertaking of such a project demonstrates at least two serious defects of moral character: an aesthetic insensitivity and the sin of hubris. Trying to change whole planets to suit our ends is arrogant vandalism. I maintain that these descriptions of character are coherent and important ethical concepts. Finally, I demonstrate how the arguments developed in opposition to terraforming, a somewhat farfetched example, can be used in cases closer to home to provide arguments against our use of recombinant DNA technologies and against the construction of tourist developments in wilderness areas.

I. TERRAFORMING

What are the ethics of human involvement with nonliving systems such as rivers and mountains and whole continents such as Antarctica? What are the ethics of our interactions with dynamic systems such as climates, ocean currents, and life’s genetic code? I want to investigate these issues in isolation from whatever ethical considerations might arise as a result of the effects our actions on these systems might have on living organisms, considered either as individuals or as members of species. My concern is solely with the ethics of our relation to complex inorganic, or nonliving, systems. The example I want to consider in order to highlight these issues is terraforming. Terraforming is the hypothetical climatic and geophysical engineering of other planets on a grand scale with the aim of turning the so-called barren planets in our (or for that matter another) solar system into habitable Earth-like ecosystems.¹ The sheer scale of such a project allows many issues which arise around other modern technologically oriented environmental projects to be writ large.

The most promising planet in our solar system as a candidate for terraforming is Mars. A number of ways of doing it have been suggested. Mars possesses polar icecaps and a layer of permafrost beneath the planet’s surface, both of which contain water along with other frozen gases. The beginnings of an atmosphere

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¹ For an excellent review of the scientific literature on terraforming and discussion of the feasibility and merits of the project, see Martyn Fogg, *Terraforming: Engineering Planetary Environments* (Warrendale, Pa.: SAE International, 1995).

could be created simply by melting these, either with fusion reactors, space-based solar-powered lasers, or collector mirrors or by spreading a thin layer of soot across the icecaps so they absorb the sun's heat, creating an atmosphere of water, carbon dioxide, and other gases. Such an atmosphere would almost certainly initially be extremely poisonous. Other processes which might be used to produce an atmosphere include the introduction of genetically engineered organisms whose life chemistry would free gases existing in common compounds on the planet's surface. Once an atmosphere exists we could modify it using genetically engineered microorganisms designed to convert existing gases and compounds into oxygen, carbon dioxide and water. Over time and with extensive human intervention this program might create seas and eventually an Earth-like and hopefully breathable atmosphere. Throughout this process, we would adjust the planet's surface temperature by intentionally manufacturing a greenhouse effect to heat it up or by placing large sheets of molecular thickness mirroring in orbit around the planet to cool it down. Once conditions were suitable, we would introduce (again genetically modified) plants and animals which could survive in the existing conditions and eventually we would create working ecosystems which in turn could support human life. The whole process is supposed to take a number of centuries, but at the end of that period there would supposedly be a new garden of Eden.²

In this paper, in addition to terraforming, I examine some cases closer to home in which the issues involved are identical, if less dramatic. I use the Mars example first to cast the issues into stark relief. I don't know whether terraforming is truly possible, let alone practical. It certainly presupposes a level of technology and expertise that we do not have, and perhaps never will. Yet, even though it sounds like an idea from science fiction (where it indeed has appeared), there is today a flourishing scientific literature on the feasibility of terraforming Mars, in which this activity is treated entirely seriously.³

Note that if it could be done, terraforming Mars would presumably create a new home for billions of people for centuries to come. If so, then no matter how high the initial cost of the project, our assessment of the consequences—be it

² Ibid., chaps. 5 and 6.

³ The scientific literature on terraforming is too extensive to be listed here. For an introduction to it see, Fogg, *Terraforming*. Fogg includes an account of the various appearances of the idea of terraforming in science fiction (pp. 13–24). The growing literature which addresses the environmental issues raised by terraforming includes Christopher P. McKay, "Does Mars have Rights? An Approach to the Environmental Ethics of Planetary Engineering," in Don MacNiven, ed., *Moral Expertise: Studies in Practical and Professional Ethics* (London and New York: Routledge, 1990), pp. 184–97; Robert H. Haynes, "Ecce Ecopoiesis: Playing God on Mars," *ibid.*, pp. 161–83; Geoffrey Briggs, "The Exploration and Utilization of the Planets," in Eugene Hargrove, ed., *Beyond Spaceship Earth: Environmental Ethics and the Solar System* (San Francisco: Sierra Club Books, 1986), pp. 104–16; and Holmes Rolston, III, "The Preservation of Natural Value in the Solar System," *ibid.*, pp. 140–82. Fogg, *Terraforming*, provides a brief discussion of the ethical issues raised and further references (pp. 490–95).

in terms of utility or some other calculation—is likely to turn out to be massively positive once we take into account the benefit for future generations. Nevertheless, the face of Mars would be totally and irreversibly transformed by this process.

For the purposes of this paper, I assume that Mars currently sustains no life and that terraforming Mars will not affect any living thing, will cause no suffering, and will violate no rights that other life forms might possess. I am therefore eliminating rights or utility-based arguments as reasons why the project should not go forward.

Despite the absence of any living systems, however, there are still extremely complex inorganic systems on Mars. Mars has a unique geography and complex chemical and physical systems, including an atmosphere and climate. Their operations over the millennia have produced many features of striking natural beauty and vast scale. Among these are a volcano, Olympus Mons, which rises twenty-nine kilometers upward from the planet's surface, spectacular dune systems, and desert canyon systems three times deeper than the Grand Canyon.

Although Mars has many features of great beauty, any aesthetic or interest-based accounts of why we should preserve these features—which proceed from the assumption that they have value because of the pleasure they provide to human witnesses—are likely to fail. The vistas of Mars have no such value because, being on Mars, we are unable to appreciate their beauty. There is no chance that more than a few human lives will be enriched or changed by taking a walk in the Martian desert and being awed into ethical reflection. The value of the beauties of Mars in terms of the pleasures or benefits that they provide for human beings are therefore minimal. Furthermore, it is also the case that Mars would probably possess many beautiful and unique features *after* terraforming, which human beings (future happy Martians) *could* appreciate as they stroll across the surface of Mars. Of course, these would be completely different from those that exist today and the aesthetic experiences which they might provide would be the result of the destruction of the existing features.

To summarize, in terraforming Mars we would be drastically altering the character of a whole planet, a unique environment which includes complex inorganic systems and possesses many features of striking natural beauty.

II. AN AGENT-BASED VIRTUE ETHICS

To what moral considerations could we turn to give us cause to pause before we embark on this project, given that we can't use consequentialist or rights based calculations? As I have described the example (and deliberately so), there are no good arguments based on the interests of humans or even other living organisms for not terraforming Mars. The only thing stopping us from radically reshaping Mars—and in doing so destroying the character of a whole planet—is lack of technical knowhow. If true, this example reveals, I believe, a shocking moral bankruptcy at the heart of our attitude toward the environ-

ment. It suggests that we have no obligation to approach the world around us with a certain humility or respect: our obligations are only to the organisms which happen to live in it. Are there *any* ethical considerations then which might give us cause to resist terraforming?

I believe that a significant set of reasons regarding projects such as terraforming can be found in the realm of virtue ethics. Virtue ethics directs our concern to the character of agents. It asks us to pay attention to the virtues and vices that we display through our actions.⁴ The particular virtue ethics that I wish to develop here draws on a distinction made by Michael Slote between two varieties of virtue ethics which he calls "agent-focused" and "agent-based ethics."⁵

Agent-focused virtue ethics are the familiar ethics of Aristotle and most contemporary virtue ethicists. According to this kind of ethics, if we wish to act rightly, rather than attempting to develop a theory of the good or of right action, we should cultivate the virtues. Despite the attention paid to the virtues, however, it is not an act's nature as a virtuous act that makes it right. For an agent-focused virtue ethics, the rightness or wrongness of an action is independent of the character of the actor and instead is presumably a function of states of affairs in the world or perhaps of some unspecifiable set of duties or obligations. The reference to the character of the agent is made necessary by the epistemology of ethical action. Only the virtuous person can perceive what the correct thing to do is in a morally complex situation. Thus, if we wish to act rightly in a particular instance, we should follow the example of the virtuous person and, if we wish to act rightly throughout our lives, we ourselves should cultivate the virtues. The acts that we perform, however, are acts of independent worth and retain their value even if they are performed out of different motives.⁶

As Slote argues, a different and more radical virtue ethics is also possible, which holds that acts are actually made right or wrong by the fact that they

⁴ The locus classicus of virtue ethics is of course Aristotle's *The Nicomachean Ethics*, trans., J. A. K. Thomson (Harmondsworth: Penguin Books, 1977). For more recent writings on virtue ethics, see Marcia Baron, "Varieties of Ethics of Virtue," *American Philosophical Quarterly* 22, no. 1 (1985): 47–53; Phillipa Foot, *Virtue and Vices and Other Essays in Moral Philosophy* (Berkeley and Los Angeles: University of California Press, 1978); Alasdair MacIntyre, *After Virtue* (Notre Dame: University of Notre Dame Press, 1984); John McDowell, "Are Moral Requirements Hypothetical Imperatives?" *Proceedings of the Aristotelian Society* 52, supp. vol. (1978): 13–29, and "Virtues and Reasons," *The Monist* 62, no. 3 (1979): 331–54; Michael Slote, *Goods and Virtues* (Oxford: Oxford University Press, 1990) and *From Morality to Virtue* (Oxford: Oxford University Press, 1992); and David Solomon, "Internal Objections to Virtue Ethics," *Midwest Studies in Philosophy* 13 (1988): 428–41.

⁵ Michael Slote, "Agent-Based Virtue Ethics," *Midwestern Studies in Philosophy* 20 (1995): 83–101.

⁶ This account of the nature of agent-focused ethics follows Slote, "Agent-Based Virtue Ethics", pp. 83–84. McDowell's treatment of kindness in "Virtues and Reasons," pp. 330–34, is a good example of this approach to the virtues.

demonstrate a virtuous (or vicious) character. For an agent-based virtue ethics, virtue is actually constitutive of right action. Rather than virtue allowing us to perceive the right action, which is made right by some complex set of facts about the world, right actions are right *because* they are virtuous. On this understanding, what makes a given action right or wrong is simply the character of the agent.⁷ Agent-based virtue ethics seem implausible at first, I think, because we tend to believe, for instance, that we call people cruel who commit a certain type of action. Most of us feel that our intuitions about acts come first and that it is the ethical status of the acts that determines the character of the actor.⁸ Nevertheless, there seems to be no reason why we cannot reverse the normal priority of intuitions and hold that the facts that we can be most sure about are the admirability or otherwise of character and motives and that our belief, for instance, that increasing the happiness of others is good, stems from the fact that it is the sort of activity that benevolent people, whom we admire, engage in. In fact, the epistemology of virtue suggests that this view is the case. It is much easier to point out those who are cruel or benevolent in a community than it is to provide a description of what counts as a cruel or benevolent act. How then can we insist that it is the morality of the acts which have the priority in determining who is virtuous and who not? Instead, we should admit, as agent-based ethics hold, that it is the virtuous (or vicious) character of the actor which makes the act virtuous (or vicious). Once we have recognized that there is no necessary reason why our intuitions about the morality of actions should be seen as fundamental, we are free to recast all our moral judgments about actions in terms of judgments about the character of agents.⁹

The ethics that I develop in what follows is agent-based. At first sight an agent-based virtue ethics looks like an extremely odd choice upon which to base conclusions in environmental ethics. Because it founds all of its ethical claims in claims about the way in which certain actions reveal the character of human beings, such an ethics seems to be paradigmatically anthropocentric. However, given the primary example that I am examining in this paper, the terraforming of Mars, it is hard to see where else we could found an ethics. I have already ruled out claims based on the sufferings or rights of other living things. The only other possible source of obligation on us is the hypothetical

⁷ Slote, "Agent-Based Virtue Ethics," pp. 83–84. The existence of this distinction is not always recognized in discussions of virtue ethics, which seems to be responsible for some of the confusion in the area.

⁸ See, for instance, Robert Elliot's criticisms of the attempt to found an environmental ethic in an ethics of virtue in "Environmental Degradation, Vandalism and the Aesthetic Object Argument," *Australasian Journal of Philosophy* 67 (1989): 199. This intuition also seems to be the root source of many of Robert Louden's criticisms of virtue ethics in "On Some Vices of Virtue Ethics," *American Philosophical Quarterly* 21, no. 3 (1984): 227–36.

⁹ See Slote, "Agent-Based Virtue Ethics," pp. 86–87, and Slote, *From Morality to Virtue*, pp. 93–96 and pp. 159–68.

and mysterious intrinsic value, which complex inorganic systems are sometimes said to possess.¹⁰ Given the many problems which beset claims about intrinsic value, the virtue ethical approach is at least worth a try.¹¹

The advantage of an agent-based virtue ethics over the more familiar and less ambitious agent-focused ethics is that an agent-based approach avoids the need for *any* account of the value of complex inorganic systems. An agent-focused ethics still seems to require some account of the value of such systems, or why it might be wrong to alter them, which is available independently of its claims that a virtuous person would not do so. Although the only way to tell that it is wrong to act in a certain way toward the nonliving environment is that a virtuous person would not do it, the reason why the virtuous person would not act that way is because it is in fact independently wrong to do so (even if it is difficult to specify why). Thus, an agent-focused ethics seems to let claims about the moral status of inorganic systems in via the back door. By making the intuitions about the virtues fundamental, an agent-based ethics avoids this difficulty.¹²

Furthermore, an agent-based ethics need not be as human-centered as it first appears. Although it must focus on the character of the human agent, some strong environmental conclusions may follow from an agent-based ethics if it is possible to show that a failure to respond to the environment in certain ways constitutes a vice or that certain sorts of responses are virtuous. These virtues (and vices) need not serve human ends. Even familiar virtues, such as kindness, which do contribute toward human happiness in an obvious fashion, often require that we respond in certain ways to circumstances around us and in this way may place demands upon us which are independent of human interests. For instance, kindness may require us to be kind to animals as well as people.¹³ The anthropocentrism of virtue ethics, therefore, need only consist of the fact that its claims are claims upon human beings. Such anthropocentrism is a feature of any ethics.

Using an agent-based virtue ethics, I argue that terraforming reveals in us two serious defects of character. First, it demonstrates that we are suffering from an ethically significant aesthetic insensitivity. We would become cosmic vandals. Second, it involves us in the sin of hubris. We show ourselves to be

¹⁰ This is in fact the approach adopted in Rolston, "The Preservation of Natural Value in the Solar System." It is discussed in Haynes, "*Ecce Ecopoiesis*," and McKay, "Does Mars Have Rights?"

¹¹ For a critique of the notion of intrinsic value in nature, see Bernard Rollin, *The Frankenstein Syndrome: Ethical and Social Issues in the Genetic Engineering of Animals* (New York: Cambridge University Press, 1995), pp. 50–60.

¹² Although no account of the value of complex inorganic systems is required by the an agent-based approach, I show below that such an approach makes possible a certain account of their value.

¹³ See Slote, "Agent-Based Virtue Ethics," pp. 86–87.

suffering from an excessive pride which blinds us to our own place in the world. In attempting to shape another planet to our ends, we are seeking to become gods. I deal with each of these claims in turn.

III. AESTHETIC INSENSITIVITY

The first vice that terraforming would demonstrate in us is a reprehensible aesthetic insensitivity—on a massive scale. Destroying the unique natural landscape of an entire planet to turn it to our own purposes reveals us to be vandals and brutes. It shows that we lead impoverished lives, being unable to respond appropriately to the beauty which is in the world (and on the worlds) around us.¹⁴ The argument that the destruction of natural environments may reveal in us a problematic aesthetic insensitivity has been made before.¹⁵ What I wish to emphasize in my account, however, is that the virtue ethics I am applying allows that a vice may be demonstrated simply because of the character it reveals in the agent and regardless of any considerations of the consequences it may have.

There are two cases which suggest that an aesthetic insensitivity is a vice that may render the destruction (or neglect) of beauty wrong simply in itself. First, the act of destroying beauty is itself reprehensible independent of any consequences that may flow from it. Even if the beauty destroyed would replace itself, it would still be wrong to destroy it precisely because doing so demonstrates an aesthetic insensitivity. This claim is best illustrated by use of an example. Consider a person who goes hiking in the Snowy Mountains early one morning and discovers, by the edge of a cutting, a stunning array of icicles, a thing of great beauty, formed when the creek which ran over the cutting at that point froze over. Moreover, the hiker knows that this display is formed anew every night and occasionally disappears completely by the end of the day. He or she also knows that no one else will be hiking that path that day. Yet, isn't it still the case that if the hiker destroys the icicles, he or she will have demonstrated a significant defect of character and lessened him or herself as a person in doing so? The person who casually runs a stick across them, thus destroying them for no reason but a petty act of will, demonstrates an insensitivity to their beauty which is

¹⁴ In "On Preserving the Natural Environment," *Yale Law Journal* 84 (1974): 205–67, Mark Sagoff is critical of arguments that we should value nature for its beauty. The real reason we should preserve natural environments, he argues, is out of respect for other, less mundane, aesthetic qualities such as majesty, fierceness, power, integrity and the like. The arguments below are also intended to work for aesthetic qualities of this sort.

¹⁵ See, for instance, Thomas Hill, Jr., "Ideals of Human Excellence and Preserving Natural Environments," *Environmental Ethics* 5 (1983): 211–24, and John Passmore, "Attitudes to Nature," in R. S. Peters, ed., *Nature and Conduct* (London: MacMillan, 1975): 263. For criticism of these claims, see Elliot, "Environmental Degradation, Vandalism and the Aesthetic Object Argument."

gross and disturbing. The destruction of the icicles suggests that the hiker has not seen them clearly. If the hiker had truly seen and comprehended their beauty, he or she could not have destroyed them. The fact that they were destroyed is not important here, except in that it points to the insensitivity of the vandal. What is significant is the blindness the hiker has displayed to beauty even though no one else may suffer from its loss. This blindness is a failing on the hiker's part. It is a vice.

The second way in which one may demonstrate a troubling insensitivity to beauty, although without destroying it, is by using it for one's own purposes in ways that make no reference to its beauty. I illustrate this point by use of another example. Take the case of someone who finds an original Van Gogh—another “Sunflowers” on hardboard—in the musty attic of his or her new house. Although this painting is an object of great—nay, extraordinary—beauty, our hypothetical discoverer merely glances at it, puts it aside, and later turns it upside down and places it on top of a crate in order to make a table on which he or she can store tins of paint. Let us suppose that doing so does not damage the painting in any way and that, because no one knew of the existence of this painting, nobody suffers any loss by virtue of its use in this fashion. Nonetheless, someone who acts in this way demonstrates that he or she is blind to the beauty of the world around him or her. The way in which someone sees the object is not the way he or she should see it. Such a person neglects what any normal person would recognize as the most significant property of the painting—its beauty. This failure to recognize beauty is deplorable.

In each of these examples, although the presence (and neglect) of beauty is necessary to demonstrate the existence of the vice, it is not the fact that beauty is destroyed or neglected that is the source of our condemnation. It is not the consequences of the action which are significant. They are, in each case, benign. Instead, it is the character flaw itself which invites our disapproval. It is true that bad consequences may flow from the vice. For instance, we would lead impoverished lives if we could not see the beauty around us. However, this fact is not the reason we should avoid the vice. To be insensitive to beauty is deplorable simply in itself, regardless of the consequences that may follow from it.¹⁶

This account of the vice of aesthetic insensitivity would be most powerful if we possessed an objectivist account of beauty. It would then require that we be sensitive even to systems which we do not find in the first instance to be

¹⁶ We can easily imagine a case in which an aesthetically insensitive person benefits from this or her blindness to beauty and also a case in which others profit as well. Perhaps a janitor is employed to burn a series of extremely beautiful and also controversial religious paintings which, if they are not destroyed, will continue to provoke dangerous riots in the community. The janitor's lack of aesthetic sensibility makes it possible for him or her to perform a task with ease, which others might be unable to complete at all or only with great suffering. Despite the benefits that all concerned reap from the janitor's failure to be moved by beauty, we would still say that it is deplorable.

beautiful but which fit some objective description of beauty. Nonetheless, the account would still work with a response-dependent or intersubjective account of beauty, in which case we would merely be required to respond to those systems that normal (or appropriately qualified) observers recognize as beautiful.¹⁷ In either case, the role played by beauty illustrates my earlier claim that an agent-based ethics need not be as human-centered as one might think. In order to avoid demonstrating a vice, we are required to respond to features of the world around us which are independent of our own interests. If an objectivist account of beauty can be provided, then we are required to respond to facts about the world which make no reference to facts about humans at all.¹⁸

IV. THE SIN OF HUBRIS

The other vice which terraforming might involve us in is the sin of hubris. Hubris is a vice, discussed in classical Greek literature and mythology, which is popularly thought to involve excessive pride before the gods.¹⁹ It occurs when humans willfully ignore their limits and seek to become like gods.²⁰ Hubris is traditionally punished by disaster. The excess of pride is the undoing of those who possess it and they are put in their place, usually roughly. The paradigmatic example of hubris can be found in the legend of Icarus, who flew too close to the sun in the attempt to reach heaven and lost his son as a result.²¹

¹⁷ See L. Duane Willard, "On Preserving Nature's Aesthetic Features," *Environmental Ethics* 2 (1980): 295–97.

¹⁸ Slote's argument that a virtue ethics can support generalized imperatives analogous to deontic moral prohibitions (*From Morality to Virtue*, chap. 10) suggests that if it is a vice to be blind to beauty, this requirement may even take the form of a deontic imperative.

¹⁹ In fact, this is a popular *misunderstanding* of the historical notion of *hybris*. For an extended discussion of the real nature of hubris/hybris in the thought of ancient Greece and for further references on this topic, see N. R. E. Fischer's *Hybris: A Study in the Values of Honour and Shame in Ancient Greece* (Warminster, England: Aris and Phillips, 1992). Despite the fact that the popular understanding does not accurately represent the original Greek notion, I am going to continue to make use of the popular concept of hubris as described above because it encapsulates the idea of a certain sort of excessive pride or arrogance which is recognizably a vice and is my interest here.

²⁰ Hill, "Ideals of Human Excellence," pp. 216–22, argues that certain actions in relation to the environment may demonstrate a failure to appreciate our proper place in the universe, which he in turn links with the absence of a proper humility or a failure to possess a particular kind of self-acceptance. My account here is in sympathy with his, but I emphasize the deplorable aspects of the active desire to transform the environment in certain ways. Lloyd Reinhardt has also suggested that transforming the environment in certain ways may be blasphemous in "Some Gaps in Moral Space: Reflections on Forests and Feelings," in D. S. Mannion, M. A. McRobbie, and R. Routley, eds., *Environmental Philosophy* (Canberra: Department of Philosophy, Research School of Social Sciences, Australian National University, Monograph Series, 1982).

²¹ The story of Icarus and Daedalus is given in most detail in Ovid, *Metamorphoses*, bk. 6. There is another account of the story in his *Art of Love*, book 2. My thanks to Colin Mayrhofer for these references.

Planetary engineering strikes me as a good candidate for the sort of project which would demonstrate hubris. We would be playing god. This sentiment is never far from the literature. The rhetoric of terraforming is quite self-consciously a rhetoric of transformation and transcendence. Terraforming is not just another project. It is a project that would make us world makers.²² It would mark the next stage of human destiny and the beginning of the conquest of space. But what about someone who denies that there are any limits on human activity? Someone who holds that there are no gods, no one to challenge, and that human beings can and should forge a glorious destiny? It is obviously unsatisfactory to rely on theistic claims about the proper place of humanity. For the argument to be convincing in modern circumstances, we must be able to give a non-theistic account of hubris.

There are two strategies we may pursue to develop such an account. The first and the easiest is to focus on the character and phenomenology of the vice of hubris. To do so, we must provide a description of hubris as an attitude and show that the project of terraforming is both the result of and a source of such attitudes. As noted above, the proponents of terraforming often seem to demonstrate an attitude which is a good *prima-facie* candidate for hubris. Classically, hubris involves glorying in one's own powers, a false optimism about them, and a haste to put them to the test. A lack of self-knowledge and self-reflection is also characteristic of hubris, as is a dismissive attitude toward both critics and past failures. All of these traits are sometimes evidenced in the discussion of terraforming. The project attracts interest simply because it *is* so dramatic and because of the proof it could provide of the supremacy of human spirit and engineering skill. This enthusiasm for terraforming looks particularly damning in the light of past technological disasters on Earth. There is little self-reflection going on in the debate about terraforming, which is largely a technical debate about feasibility and methods and which allows little room for questions about why we would want to engage in such a project.²³

Thus, the attitudes surrounding and driving terraforming seem to fit the phenomenology of hubris. But this strategy will not, I suspect, prove effective against an entirely serious (including morally serious) and reflective advocate of terraforming who denies that any of the above attitudes are involved and who challenges the conservative and parochial consequences of the critique. Although

²² Tellingly, in his preface to *Terraforming*, Fogg himself names the desires to transform worlds as *hubris* (p. xi). The subtitle to Haynes' essay "*Ecce Ecopoiesis*" is "Playing God on Mars," in reference to concerns which he suggests were immediately raised when he broached the subject of terraforming at a NASA committee meeting in 1967. Obviously some of the advocates of terraforming are acutely conscious of the grand scale of their ambitions.

²³ There is admittedly, at various points in the debate, recognition that the project raises difficult issues in environmental philosophy (see note 3 above for references). There is some debate over whether or not it is a project we should undertake. But what is lacking is reflection on why we might want to undertake it.

the attitudes described above are all, as a matter of contingent fact, demonstrated by current advocates of terraforming, it remains to be argued that they are always likely to be so. In order to meet objections of this type, we need to try to show that the sin of hubris involves a reference to certain sorts of projects. The above attitudes are all part of the burning desire to transgress our limits. We need to give some account of our limits and to show that terraforming is outside of them.

The second strategy is thus to try to formulate a (non-theistic) account of humanity's place in the cosmos and of appropriate limits to human activities, in order to show that projects which transgress these demonstrate hubris.²⁴ It is important to understand that this argument is an attempt to show that seeking to transcend certain limits demonstrates hubris, and is therefore wrong, rather than an attempt to show why seeking to transcend certain limits is wrong, and therefore demonstrates hubris. It is intended to remain within an agent-based framework. We need an account of our limits in order to better show when people are trying to overcome them. Nevertheless, the fact that trying to do so is wrong is solely a function of whether it demonstrates hubris or not, which also depends on any other number of things.²⁵ How do we distinguish these limits? Again it seems to me that there are two ways we might seek some guide to the limits of proper human action.

The first moves indirectly toward an account of our limits by focusing on the nature of our actions and by arguing that certain features are characteristic of projects which seek to transcend our proper limits. There is often a significant relation between our actions and the projects they are part of. In the case of hubris, acts of hubris are usually large, dramatic, and unprecedented acts. They are usually punished by disaster. The pride and the fall go hand in hand. The possibility of disaster, then, of failure which would bring us low, operates as a sign of hubris. Terraforming certainly involves the possibility of catastrophic failure. Given the scale of the project and the amount of energy involved, failures are likely to be disastrous. Instead of a habitable planet, we may produce one with a poisonous atmosphere or without water or lashed by continual typhoons. Indeed, given the amount of resources and human effort which would need to be dedicated to terraforming, anything other than complete success would be a disaster. Note that it is the possibility of disaster rather than its probability which is important here. I am not arguing that the

²⁴ This project is, I believe, an important one even outside of the context of the current argument. It seems to me that any complete ethics would provide an account of what it is to lose our humanity and of why this loss has often been thought to be one of the greatest disasters which can befall a moral agent. There are some desires, such as the desire to become immortal or to be as gods, which if we were to realize them, would involve the loss of our humanity. We need some account of why such projects are monstrous.

²⁵ As I argue below, at the very least it depends on the history of the agent and the context of his or her actions.

risks are too great or that the costs of failure are too high. Instead, the possibility of a catastrophic failure which would reveal our ambitions as arrogant and futile acts as an indication that the project is one which oversteps the limits of our wisdom and abilities.

Second, we might attempt more directly to flesh out the idea of our own proper human place. We could try to gain a sense of possible limits to the ambitions which are appropriate to human beings. When considering terraforming, because the limit we are considering here is the physical limit of being confined to a single planet, it seems fair to invoke the metaphor of our proper place in a spatial sense. However, this metaphor can also be understood more generally to pose the question of our proper place in the scheme of things or the limits of the sphere of human activity.²⁶ To say that some location or area is our proper place is not an empty thought. It implies a certain relation of appropriateness in our presence there. A proper place is one in which one can flourish without too much of a struggle. It is one that we can live in and sustain. It is a place in which one fits and does not appear uncomfortable or out of place.

It is *prima facie* implausible to suggest that Mars is our proper place. The vast amount of effort required for us to sustain a presence there, even to the point of entirely transforming the planet, indicates that it is not a natural environment for us. Our presence there would be analogous to that of a penguin in the Sahara or a rabbit underwater. If we have to wear space suits to visit and to completely remodel it in order to stay, then it's simply not our place. Another way to try to understand our proper place is by relating it to the idea of a home. It seems natural to say of most creatures, at least as individuals and perhaps as species, that they have a home. This is a place which nurtures them, in which they grow up, reproduce and which offers them some semblance of safety. It is difficult to say of human beings collectively, who have colonized all reaches of the globe, where our home is. But "Earth" looks like a plausible answer. Planets seem to have a certain status as possible homes for creatures because of their nature as whole systems on which life can evolve. The relation between the idea of a home and the idea of our proper place that I am suggesting is an ethical one. Our proper place is at home until we have shown that we are mature enough to leave it. Whether or not people are ready to leave home depends on how well they live at home and how they look after that home. On this test, the

²⁶ Hill, "Ideals of Human Excellence," discusses what might be involved in appreciation of our place in the universe (pp. 216–20). His discussion links it to a certain sort of humility. While suggestive, Hill's treatment of the issue is obviously not sufficient for my purposes. If our proper place is defined by reference to humility (or the absence of hubris) then my argument that to seek to transcend it demonstrates hubris will be circular. Reinhardt's meditations in "Some Gaps in Moral Space" on the attitude that it is appropriate for us to take toward nature are less obviously so and are useful in this regard. My argument here rests on the hope that it is possible to give an account of our proper place which is conceptually independent of intuitions about hubris (or humility).

human species does not look well qualified to start moving out to other planets. We must show that we are capable of looking after our current home before we could claim to have any place on another. For the moment, at least, our proper place is on Earth and the desire to colonize other planets is indicative of hubris.

These arguments are explicitly parochial. They claim that human beings are limited creatures with a proper place in the natural world, whose ambitions should not seek to escape these limits.²⁷ Note, however, that even denying that human beings have any fixed or proper place in the universe is not necessarily a denial that we have a proper place at the moment. It may be that humans have ultimately no fixed place in the universe, that it is in our nature to explore, wander, and alter our environment. But this is not to say that we cannot fix our place at a given time. History and context are important here. One can grow into a place, or show that one's place has become too small, or (more likely) show that one is not suited to occupy one's current place. Given the current state of this planet's ecosystem and the responsibility that human beings bear for this state, I think one would be hard-pressed to argue that we are morally fit to assume control over another. Until we heal the Earth, we have no claim to any further space.

Finally, notice that hubris is a paradigmatic example of an agent-based vice. If we think poorly of someone who demonstrates hubris, it is solely because of what they have revealed about their character. Although, as I have argued, the risk of disaster plays some role in determining what sorts of actions demonstrate hubris the *actual* consequences flowing from these actions are not relevant to our assessment. Indeed, there may be no ill consequences resulting from hubris. Those who commit hubris may get away with it and their projects may succeed.²⁸ Nonetheless, we may still deplore the character that they have demonstrated.

V. SOME FURTHER REFLECTIONS

The arguments above, because they proceed via our character, still fall short of justifying a total injunction on terraforming. Rather, they suggest that we examine ourselves and how the project reflects on our character before we undertake it. I have tried to show that terraforming is likely to reflect poorly on our character because it involves a blindness to beauty and an excessive faith in our own judgments and abilities. The nature of the project is such that the

²⁷ I am not sure how to argue further with someone who denies this absolutely, in the sense of denying that there should be any limits on human activity or that humans have any place in the world. Indeed, denying our limits simply looks to me like hubris. It may be that the intuition about hubris is foundational—which should not surprise us in an agent-based ethics.

²⁸ It is true that it is internal to the popular concept of hubris that those who commit it are often punished with disaster by the gods. But such punishment befalls us because hubris is a vice. It is not a vice because we are punished for it.

onus is on those who wish to engage in it to show that they do not display these vices. But it remains possible that the project might be undertaken with a different motivation and character. If, for instance, terraforming were a project undertaken with genuine reluctance, in full knowledge of what was being destroyed, because no alternative existed for the survival of the human race, then it would not demonstrate hubris—because hubris involves an enthusiasm for its projects. If it were the case that those involved were fully aware of the beauty that they were destroying and demonstrated genuine regret over the fact, then terraforming might not involve a blindness to beauty either.

Note also that when we make assessments about character, we ordinarily take history and context into account. When a parent who has a long history of acts of kindness seems to act cruelly toward his or her child on a particular occasion, we may reassess our judgment of his or her actions in the light of his or her history and conclude that this act may well also be a kind one, although we do not yet understand why.²⁹ Virtues and vices develop and are displayed over extended periods of time, as well as in particular instances. In some cases, our knowledge of an agent's history gives us reason to alter our judgment about a particular act. In others, our knowledge of their history only confirms that they are acting deplorably on this occasion.

These examples suggest that the history of our relation to our current planet is relevant to an assessment of the ethics of terraforming another. If we have been insensitive to the beauty of our own planet, then it is likely that we may be equally insensitive in our designs on another. If we are suffering the consequences of our hubris on Earth (environmental disaster), then it is unlikely that we have left that hubris behind when we desire to terraform Mars. On the other hand, if we can demonstrate a reformed character in our attitude toward the Earth, then perhaps one day we can look to inhabiting other planets without being convicted of these vices.

VI. APPLYING THESE PRINCIPLES TO OTHER CASES

If my argument in this paper was relevant only to the hypothetical project of terraforming, then it would be of academic interest only, at least for the foreseeable future. It should be obvious, however, that the environmental ethics developed above can be applied in other cases. Wherever the consequences of some action which impinges on the environment are positive or neutral for all sentient creatures and the action involves no plausible violations of any rights that nonhuman organisms may possess, the agent-based virtue ethics I have

²⁹ Of course, we may also judge, because his or her act is of the sort that others notorious for their cruelty engage in, that he or she is demonstrating a vice in this case. But in either case our judgment moves from our assessment of the character to our assessment of the act.

been developing may yet give us reason to reconsider the action. Two cases in particular look like promising candidates for the application of agent-based virtue ethical arguments: nondestructive tourist developments in wilderness areas and the development and application of recombinant DNA technologies. I want to make a few brief comments about each of these.

As a direct result of the success of the environmental movement in placing environmental values on the political agenda, the proponents and architects of many new developments in wilderness or other areas of natural beauty take special care nowadays to ensure that their projects can be defended against environmental critics. They try not to kill or disturb animal populations in the area of their development and to revegetate cleared areas. They even attempt to ensure that their developments blend in or are appropriate to the areas in which they intend to build them, so as not to destroy the aesthetic values of the surroundings and (more importantly) so that they do not ruin the wilderness experience for their paying customers. Depending on the case then—and on the amount of money developers are prepared to spend to meet environmental concerns—measures of these sorts may defuse any arguments based on the sufferings of living creatures affected by the development or on violations of their rights or even on the loss of the pleasures of aesthetic experience to those who visit the area. Arguments based on the sufferings of living creatures, rights violations, or the loss of aesthetic values are simply not going to work in these cases.³⁰

But the virtue ethical considerations discussed above may well be relevant and give us grounds to oppose such developments. In particular, projects of this sort may demonstrate a deplorable aesthetic insensitivity on the part of those who propose or support them. To put it bluntly, there may just be something crass about proposals to build ski resorts inside mountains, tree-top cabins in the rain-forest canopy or monorails in the desert. There will be cases where no one who genuinely appreciates the beauty and nature of an area would dream of interfering with it in any way, let alone building a resort in the middle of it, no matter how environmentally friendly it may be. The very thought of doing so is indicative of a failure to properly appreciate and respond to the uniqueness, beauty and integrity of a wilderness area. There need be no evil consequences which flow from such an insensitivity—it is deplorable in itself. An agent-based virtue ethical argument about the vice of insensitivity to beauty may work, then, to give us reasons to criticize such projects. Furthermore, faith in our right to disturb the environment in this manner, or in our ability to improve, it may demonstrate substantial hubris as well. Depending on the case and on the factors discussed earlier we may be able to argue that the desire to undertake

³⁰ For a discussion of such cases, see Sagoff, "On Preserving the Natural Environment." For a discussion of similar cases, see Robert Elliot, "Faking Nature," in Robert Elliot, ed., *Environmental Ethics* (New York: Oxford University Press, 1995), pp. 76–88.

certain projects reflects a dangerously exaggerated and morally reprehensible faith in our own wisdom and power and in our right to dominate the world around us.

The ethics of the development and application of recombinant DNA technologies (genetic engineering) is another case in which it is extremely difficult, if not impossible, to make arguments to oppose the project based on consideration of its consequences. In the abstract at least, the advocates of genetic engineering can promise us the world—cures for cancer, food for the starving, etc. In the face of such promises, it is difficult for reservations about the dangers inherent in the technology, or about who should control such power and to what purposes, to count for much. Furthermore, by and large, the only people qualified to assess the technical dangers and the adequacy of the safeguards involved in the technology are those already implicated. Given the magnitude of the benefits promised and the difficulties in quantifying the risks involved, arguments against the development and use of this technology based on assessing the consequences for human beings even, let alone all living things, will be extremely difficult to carry. Nor is it obvious that any violations of the rights of individual organisms or species are involved in the application of recombinant DNA technologies. In most cases, the organisms involved are microbial or vegetable and thus unpromising candidates for bearers of rights.³¹

Although arguments based on the ill consequences for living things or of putative rights violations involved in genetic engineering are extremely weak, an argument against the use of recombinant DNA technologies on the grounds that the desire to develop and employ them demonstrates hubris, along the lines discussed above, is potentially very powerful.³² Considered as a whole project, genetic engineering shares a number of features with terraforming. It is a massive project, which offers the possibility of turning life itself to our own purposes. Indeed, so large are its ambitions and so extensive are its implications that genetic engineering has often been condemned as playing god.³³ The nature of the debate around genetic engineering parallels that surrounding terraforming in that a can-do enthusiasm (not to mention the drive for profit) has overridden qualms based on more serious ethical reflection. Despite this enthusiasm, the possibility of disaster as the result of genetic manipulation looms large. Genetically modified organisms may interact with natural ecosystems in unpredictable ways with unknown and potentially catastrophic envi-

³¹ See, for instance, John Passmore, *Man's Responsibility for Nature* (London: Duckworth, 1974), p. 115, and Reinhardt, "Some Gaps in Moral Space," pp. 192–97.

³² The possibility of a virtue ethical critique of genetic engineering is raised in Bernard Rollin's *The Frankenstein Syndrome*, pp. 29–32. His critique is based on the notion that methodological reductionism is a vice. If faith in our ability to understand a living system by treating it as merely a complex system of particles is hubris, or if to treat living systems in this way is to be blind to their beauty, then the argument he discusses is in fact a version of those below.

³³ Or as Rollins expresses it, as being the "Frankenstein Thing" (*ibid.*, pp. 1–6, 21–24).

ronmental consequences.³⁴ The desire to be able to manipulate the genetic code is a desire to overcome the limits placed by our ignorance on our interactions with the natural world. Genetic engineering arguably also seeks to remove us from our proper place in relation to the natural world. The ability to control and alter the genetic code transforms the genetic diversity of the natural world from the context of human action to an object of such action. Instead of being creatures within nature, we become creatures for whom nature is an object of our manipulations.³⁵ In all these ways, the desire to be able to engineer genes is akin to the desire to be able to engineer planets, and the arguments with which I sought to show that the latter project involved hubris also apply to the current example. If hubris is a vice at all, then surely the desire to develop and apply recombinant DNA technologies demonstrates it and is thus to be deplored.

Genetic engineering may demonstrate an aesthetic insensitivity as well. A proper appreciation of the complexity and diversity of the genetic code of life may involve the recognition that it has a certain sort of beauty. It is the marvelous product of millions of years of evolution. To view it simply as a chain of molecules to be manipulated to our own purposes is arguably to be blind to this beauty. A similar argument may be made at the species or ecosystemic level with regard to biodiversity. The web of life is itself a thing of great beauty. To wish to replace existing biodiversity with monocultures, no matter how productive or sophisticated, is like wanting to edit *Paradise Lost* down to two pages. If we grant that the existing natural order is beautiful in either of these ways, then the desire to manipulate it with recombinant DNA technology may demonstrate a deplorable blindness to this beauty.

An advantage of the virtue ethics critique of genetic engineering which deserves a mention is that it bypasses a powerful defense of genetic engineering, according to which it is essentially nothing new. One response to arguments about the immorality of modifying the genetic code through genetic engineering might be to point out that human beings have always altered the genetic code of other species unintentionally by modifying their environment and thus imposing selection pressures on them and also intentionally through breeding programs. Many of the animals and plants most familiar to us only have the shape they have today because of countless generations of breeding and domestication. Genetic engineering is essentially nothing new then, just a series of more efficient techniques for doing the same thing.³⁶

³⁴ Notice that because it is the possibility of disaster which is relevant here, rather than the probability, the need to argue with the genetic engineers on their own territory is mitigated. We don't need to prove that something is likely to go catastrophically wrong, only to point out that it might and that this possibility is endemic to the project. When such a possibility is present, it is a sign that a project involves hubris.

³⁵ See Bill McKibben, *The End of Nature* (New York: Random House, 1989), pp. 166–70.

³⁶ For an extended discussion of the degree to which human beings have altered the genetic make up of the species around us see Colin Tudge, *The Engineer in the Garden* (London: Jonathon Cape, 1993), chap. 6.

Although the consequences of the project can—by a large stretch of the imagination—be seen as contiguous with breeding and domestication, these activities look very different in a virtue ethics light. Genetic engineering and animal breeding involve very different practices and relationships between their human practitioners and their animal subjects. As a result they involve the cultivation and manifestation of very different virtues. Animal breeding requires extended contact with individual animals, involving an ethically significant mode of attention to them, kindness and in some cases love.³⁷ Genetic engineering, on the other hand, involves a series of scientific virtues such as patience, objectivity, and the drive to knowledge. The emotional investment in individual animals which is arguably a feature of successful animal breeding is likely to be a disadvantage when it comes to being a genetic engineer. These distinctions allow us quite plausibly to hold that one of these projects may be virtuous and the other vicious.³⁸

The role played by the history of an actor and the context of his or her actions in determining virtue allows a certain flexibility in these arguments. Although I have argued that the nature of these projects is such as to suggest that those engaging in them are likely to be deplorable, if it can be shown that the motivation and thus the character of an agent involved in one of these projects is substantially different from those I have described, then the project may not be wrong. Thus, recombinant DNA technologies designed to save lives may be rendered virtuous by this motivation while projects motivated simply by scientific curiosity or the desire for profit may remain vicious due to the hubris involved. The history of our past and current attempts to manipulate the biosphere are also relevant to assessment of the ethics of new attempts, such as genetic engineering. Given that that history is, by and large, a history of disaster, it gives further weight to the claim that the new and even more ambitious attempts involving genetic manipulation display hubris. If we wish to claim that we can exercise our proposed new powers responsibly, we would do well first to address and repair the damage we have done in the past.

VII. CONCLUSION

The answer to my inquiry at the beginning of the paper about the ethics of our interactions with complex inorganic systems is that our actions toward them should be governed by reflection on how those actions reveal our character. We

³⁷ For the beginnings of a discussion about the ethical relations involved in animal breeding, see Vicki Hearne, *Adam's Task: Calling Animals by Name* (New York: Alfred A. Knopf, 1986).

³⁸ To be fair, this argument compares genetic engineering with small-scale animal breeding programs carried out by individuals. Modern scientific breeding programs carried out for agribusiness may in fact be much closer in character to the manipulations of the genetic engineers. To my mind, however, modern large-scale agricultural programs may themselves be vicious in comparison to older, more traditional practices.

should pay heed to the sort of creatures that we demonstrate ourselves to be through our actions—even when our actions affect no living things. We should cultivate virtues and avoid vices in our relation to the natural world.³⁹ I have argued that there are two vices in particular that we may display when we act to modify the world around us: an insensitivity or blindness to beauty and hubris and an excessive pride or faith in our own abilities which motivates us to try to transcend our proper limits. When we contemplate leveling mountains, reclaiming deserts, damming rivers, or deliberately changing the climate, we should pause to reflect on whether we reveal ourselves to be blind to their beauty in doing so or to be suffering from hubris. I have also tried to show how the construction of tourist resorts in wilderness areas and the development and use of recombinant DNA technologies might involve us in both these vices.

Finally, as I suggested above, the agent-based virtue ethics that I have developed here makes possible a further account of the value of complex inorganic systems. They have value by virtue of the character traits that they can expose in us. They are a sort of moral touchstone. We should treasure them because they allow us to demonstrate certain virtues and vices and thus potentially allow us to become better people. But, while this reason to preserve such systems is a consequence of my agent-based account, it is itself not a reason within that account. This value that complex systems have is not, at least initially, the reason why we should not destroy them. We should not destroy them when it would be deplorable to do so. Furthermore, although being deplorable is not a function of the fact that such systems allow us to demonstrate the virtues, this fact may provide a further instrumental and explicitly anthropocentric reason for preserving them.

³⁹ I have focused on vices in this paper because my concern has been to show why we should not engage in certain sorts of projects. But it will also be true that for each of the vices I have discussed there is a corresponding virtue. We should aim to cultivate within ourselves an appreciation of the beauty of the world around us and, in place of hubris, we should seek to instill in ourselves a humility in the face of the natural world and a sense of our own limited place within it. The existence of such virtues explains why we may perceive activities such as bushwalking or gardening to be admirable, as well as why we find much to admire in the attitude of some indigenous cultures toward the world around them.