

# Biotechnology and Monstrosity

*Why We Should Pay Attention to the "Yuk Factor"*

by MARY MIDGLEY

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We find our way in the world partly by means of the discriminatory power of our emotions.

The gut sense that something is repugnant or unsavory--the sort of feeling that many now have about various forms of biotechnology--sometimes turns out to be rooted in articulable and legitimate objections, which with time can be spelled out, weighed, and either endorsed or dismissed. But we ought not dismiss the emotional response at the outset as "mere feeling."

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What kinds of moral objections are there to such interventions as xenotransplantation, genetic engineering, and bio-engineering generally? Ethicists today often divide moral objections firmly into two sets, those that point to dangerous consequences and those saying that the act itself is intrinsically wrong. Of course this division between act and consequence is often useful. But unless the two angles are brought together again at some point it can split the subject disastrously.

It is often very hard to consider probable consequences on their own because we really do not know what they are likely to be. On the other hand, trying to consider intrinsic objections on their own, apart

from consequences, often seems unrealistic. We are inclined to feel that these direct objections must be irrational because the only rational way to judge things is--as the utilitarians suggest--by weighing their consequences. Many people are inclined to dismiss intrinsic objections as emotional, subjective, something that can't really be justified or argued about at all. But as just noticed, the probable consequences themselves often are not clear enough to make reasoned conclusions possible either. So both lines of inquiry fail.

I want to suggest that it is usually a bad idea to see debates in this way as flat conflicts between reason and feeling because usually both thought and feeling are engaged on both sides. In the case of bio-engineering, I think it is especially unfortunate that people often now have the impression that while feeling is against them, reason quite simply favors the new developments. This kind of stereotyping paralyzes us.

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There seems no way in which we can arbitrate between these very different litigants.

Debate, however, is hardly ever really between these two. Feelings always incorporate thoughts--often ones that are not yet fully articulated--and reasons are always found in response to particular sorts of feelings. On both sides, we need to look for the hidden partners. We have to articulate the thoughts that underlie emotional objections and also note the emotional element in contentions that may claim to be purely rational. The best way to do this is often to start by taking the intrinsic objections more seriously. If we look below the surface of what seems to be mere feeling we may find thoughts that show how the two aspects are connected.

In the case of biotechnology, I think that such thoughts do indeed emerge. What is really worrying the objectors is not, I think, the detail of any particular proposal. It is the hype, the scale of the proposed project, the weight of the economic forces now backing it, and the sweeping change of attitude that is being demanded. Biotechnology on the scale that many people are currently proposing appears not to be compatible with our existing concepts of nature and species--concepts that are part of our current science as well as of everyday thought. And a new ideology is being proposed that would remodel those concepts to fit the new technologies, envisaging species as unreal and nature as infinitely malleable.

These vast aspirations may of course be cut down to size in any case by hard experience. Many of the hopes offered may be disappointed, as happened with earlier technological miracles such as nuclear power. But whether this happens or not, it seems important to be critical of attempts like this to remodel our whole idea of nature on the pattern of one particular, currently favored technology. We now know that eighteenth-century mechanists were mistaken in

supposing the world to be made of clockwork, and a twentieth-century repetition of their overconfidence does not seem likely to prove any more lasting. Questions about biotechnology therefore raise issues not only about the relation of thought to feeling and of acts to consequences but also about where our world pictures come from and what needs to happen when we change them.

### Getting What We Ask For

To begin, however, with the question of acts and consequences. It is interesting to notice that some consequences are not just a matter of chance. Acts that are wrong in themselves can be expected to have bad effects of a particular kind that is not just accidental. Their badness follows from what is wrong in the act itself, so that there is a rational, conceptual link between them and their results. These consequences are a sign of what was wrong with the act in the first place.

I shall suggest later that this kind of connection between act and consequence does indeed help us to make sense of the objections raised to bio-engineering. But we should notice first that this kind of reasoning isn't something new and sinister. It is commonplace in other realms of morals. For instance, it is no accident that habitual and systematic lying, or habitual and systematic injustice, have bad effects in human life. These habits can be expected to destroy trust and mutual respect, not accidentally, but because accepting those consequences is part of the act. Acts of lying or injustice are themselves expressions of disrespect and untrustworthiness, so they naturally call for more of the same. Similarly, institutions such as torture, or slavery, or any gross subjection of one class to another, have moral consequences that are not accidental. We can expect those moral consequences to follow, not because of a contingent causal link (like expecting that some-

one may be killed by a tornado) but because they are effects that anyone who acts in this way invites and is committed to accepting. Slavery asks for resentment, bitterness, and corruption--attitudes that unavoidably produce the sort of acts that express them. In a most intelligible phrase, those who institute slavery *get what they are asking for*. Hubris calls for nemesis, and in one form or another it's going to get it.

This language of "getting what you asked for" seems to me important. It has been heard on all sides and from all kinds of people in Britain lately about "mad cow disease." This disease apparently arose because, in order to save expense, sheep's brains, along with other animal waste, were used as an ingredient in cattle feed. This device transferred a disease of sheep to great numbers of cattle, who had to be slaughtered. The disease then spread to humans who had eaten the beef, giving an indefinite and still increasing number of people a new and disastrous illness known as Creutzfeldt-Jacob disease.

People who say that this kind of consequence might have been expected are not, of course, saying that there is a particular causal law to the effect that "feeding animal waste to herbivores always gives them an illness that can ravage the meat industry and then destroy humans." Nor are they saying that "wickedness is always punished." Their thought is less simple and has both a moral and a causal aspect. It runs, I think, something like this: "You can't expect to go on forever exploiting living creatures if you don't pay some attention to their natural needs. You ought not to be trying to do that in the first place. Neglecting the species-nature of cows is wrong in itself. It is a gross insult to the life of the animals. So it should be no surprise that this insult upsets their health, with unpredictable further consequences. These consequences are not, then, an accident. They flow directly from the moral obtuseness that goes with greed."

## The Role of Feeling in Morals

I have not said anything yet about how far this way of objecting is justified. I am merely explaining it. Later on I want to look more closely at some of the ideas involved in it, especially at the key concepts of “species” and “nature.” But just now I want simply to spell out its reasoning, pointing out that it is not just a formless emotional cry. These people are not, as is sometimes suggested, merely expressing an inarticulate disgust at the unfamiliar by exclaiming “yuk.” Their further conversation shows that they are saying something intelligible, something that needs to be answered. To state the point briefly, they are objecting to attacks on the concept of species. And in my view there is good reason for that objection.

This point needs to be made because direct, intrinsic objections to bio-engineering often are seen as being beneath the level of the real argument. They are described as “the yuk factor.” They may still be treated with respect for political reasons, because they are known to be influential. And they may also be tolerated because of a general belief that all ethics is irrational anyway—a notion that feeling is always separate from reason—so that their wildness is not particularly surprising. Often, too, these objections are expressed in religious language, and many people now seem to think that religious language cannot be understood by outsiders. Religious thought is conceived as being so isolated from the rest of our reasoning as scarcely to count as thought at all, so this, too, can make them seem undiscussable. (For that reason I shall avoid religious language in this discussion, trying to keep it entirely in secular terms.) Thus current forms of relativism and subjectivism can generate a mindless approach to morals, a sort of weary tolerance of sensible and foolish scruples alike.

I think we can do better than this. We can try to understand them.

In the first place, I am suggesting generally that the “yuk factor,” this sense of disgust and outrage, is in itself by no means a sign of irrationality. Feeling is an essential part of our moral life, though of course not the whole of it. Heart and mind are not enemies or alternative tools. They are complementary aspects of a single process.<sup>1</sup> Whenever we seriously judge something to be wrong, strong feeling necessarily accompanies the judgment. Someone who does not have such feelings—someone who has merely a theoretical interest in morals, who doesn’t feel any indignation or disgust and outrage about

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things like slavery and torture—has missed the point of morals altogether.

Of course we know that these feelings are not an infallible guide. Of course we need to supplement them by thought, analyzing their meaning and articulating them in a way that gives us coherent and usable standards. Unanalyzed feelings sometimes turn out to be misplaced. Disgust can spring from chance associations or unfamiliarity or mere physical revulsion, such as a horror of cats. We always have to look below the surface. We must spell out the message of our emotions and see what they are trying to tell us. And we have actually quite a good, flexible vocabulary for doing this, for articulating their meaning and seeing how much it matters.

For instance, if people say that agriculture or contraception is unnatural, others can understand what objection they are making. Agriculture was indeed the first move in shifting human life away from the approxi-

mate balance with its surroundings that seems to have marked a life spent in hunting and gathering, and contraception is indeed a considerable interference with a central area of human social and emotional life. These are real objections that can be spelled out, made clearer, and weighed against other considerations. All parties need then to think about this balance and to ask what matters most. This is where the thinking comes in. Gradually, given time and good will, agreement is often arrived at. This has happened about unnumbered issues in the past, often resulting in the whole issue being forgotten. The work may be hard, but in principle these are matters that can be decided in rational terms. They are not ones that must be left to a brute clash of inarticulate feelings, even though they arose from feelings in the first place.

Nor is the notion of something’s being wrong because it is unnatural an idle one. Suppose that someone suggests that it is unnatural to bring up children impersonally without individual bonds to carers—as Plato proposed, and as modern theorists like Shulamith Firestone and the behaviorist J.B. Watson have also demanded. Or that it is unnatural to prevent children from playing or to keep them in solitude. Most of us are likely to agree with this objection, to accept its language, and to feel outrage if these things are seriously proposed.

The notion of human *nature* has, of course, often been distorted and misused. Yet it is clear that we still rely on it on such occasions. Such is also true of human *rights*. Those rights are supposed to follow simply from membership in our species. They are not canceled by culture, as they would be if we were simply the products of that culture and had no original nature. They are rights that are supposed to guarantee the kind of life that all specimens of *Homo sapiens* need—a kind different from that which might suit kangaroos or

limpets or even pure disembodied minds. That is why people complain that human beings who are badly treated have been “treated like animals.” It is taken for granted that we know what a distinctively human nature demands.

This point can be difficult to remember today. The notion of human nature has often been misused for political purposes by people wanting to resist reform, so it has been well pummeled during the Enlightenment. But that doesn’t mean we can do without it.

Of course this notion, like many other important ones, is many-sided, wobbly, and often obscure. It is so because our nature is complex and often makes conflicting demands, between which we have to arbitrate. But we cannot dispense with the notion and we never really try to. It is a standard we must use whenever we want to assess and criticize our institutions. We need some conception of the human nature that we think they ought to fit as a criterion for judging them. We are always developing and updating that notion, but we never try to do without it. It is an essential tool for understanding both our own moral reactions and other people’s, rather than merely fighting about them. Accordingly, when people who are worried about new technologies complain that they are unnatural, we should try to understand what they are objecting to. We might find something serious.

A notable example in our tradition occurred when people began to be sensitive about cruelty, which they really had not been before. In the sixteenth century a few bold people, such as Montaigne, began to express disgust and outrage about judicial torture and the use of cruel punishments, and also about the abuse of animals. They said that these customs--which had until then been taken for granted as perfectly normal and justified--were *monstrous*, *unnatural*, and *inhuman*. Because of the strength of their indignant feeling, other people listened and gradually

began to agree with them. Thus during the Enlightenment, the “humane” movement gathered strength, articulated its objections, and became a real political force. People began to think seriously that it was a bad thing to inflict suffering when you didn’t need to. They no longer felt that they ought to repress their sympathetic feelings as unmanly. Attention to that range of sympathetic feelings stirred up reasoning that altered people’s whole world view. It called for different ideas about the entire status of humanity and of the natural world that we inhabit--ideas that are still very important to us today.

### How Solid Are Species?

Let us turn, then, from this general discussion to listen for a moment to the people who now express their disgust about bio-engineering and ask what these objectors are thinking, rather than merely what they are feeling. There are, after all, quite a lot of them, many of them thoughtful people, who have strong views about it. As Jean Bethke Elsh-tain put it in a recent article on cloning:

This is an extraordinarily unsettling development. . . . It was anything but amusing to overhear the speculation that cloning might be made available to parents about to lose a child, or having lost a child to an accident, in order that they might reproduce and replace that lost child. This image borders on obscenity. . . . The usual nostrums are no use here. I have in mind the standard cliché that, once again, our ethical thinking hasn’t caught up with technological “advance.” This is a flawed way to reflect on cloning and so much else. The problem is not that we must somehow catch up our ethics to our technology. The problem is that technology is rapidly gutting our ethics. And it is our ethics. Ethical reflection belongs to all of us--all those agitated radio callers--and it

is the fears and apprehensions of ordinary citizens that should be paid close and respectful attention.<sup>2</sup>

This is surely a reasonable demand, whether we are eventually going to agree with their objections or not. And their thought is not, I think, particularly obscure. It centers on the concept of the *monstrous*. Bio-engineering, at least in some forms, is seen as monstrous or unnatural, in a sense that means a great deal more than just unusual or unfamiliar. This sense is very interesting and needs to be examined.

The natural element that is seen as threatened here centers on the concept of a species. Our tradition has so far held that the concept of species should be taken pretty seriously and that the boundaries of a species should be respected. At a popular level, this view is reflected in the symbolism of our myths. Traditional mixed monsters--minotaurs, chimeras, lamias, gorgons--stand for a deep and threatening disorder, something not just confusing but dreadful and invasive. Although benign monsters such as Pegasus and archangels are occasionally found, in general the symbolism of mixing species is deeply uncanny and threatening. Even less mixed monsters, such as giants and three-headed dogs, are so framed as to violate the principles of construction that normally make life possible for their species. They too are usually seen as alien and destructive forces.

It is also noticeable that science has up till now supported this tradition by taking species seriously and in general still does so today. Of course we now know that species are not timeless essences--that they can be formed and can change and decay--and also that a few species hybridize and mingle at their borders. All the same, on the whole biologists still see species as sharply and profoundly shaped by the niches that they occupy. Fertile hybrids are known to be rare and usually unsuccessful. Current biology tends to stress rather

strongly the extent to which each species is adapted to fit its niche and must keep all its parts exactly suited to each other if it is to survive. Biologists are now much given to studying *evolutiona functions* --to asking why creatures have just this or that set of characteristics and explaining how this set is needed to fit them for their own peculiar way of life.

On the whole, then, today's evolutionary biology tells us that however much we might want to have a world filled with novelties and monsters, chimeras and winged horses and three-headed dogs, we can't, because in the real environment these would not be viable life forms. We can make mice with human ears on their backs in the laboratory, but they could not survive in the wild. Similarly, the lion-tiger hybrids that can sometimes be bred in zoos could not make a living in the habitat of either parent species. Their muddled mixture of inherited characteristics unfits them for either parent's life-style. In fact, it appears that actually very few evolutionary niches are available at any given time, and that these are normally far apart, accommodating only the rather widely varied creatures that now occupy them. Most of the territory between is not currently habitable. That is why there have been so many extinctions--threatened species could not usually find somewhere else to go. Any change that is not directly demanded by altered outside circumstances is likely to be lethal. Evolution, in fact, knows what it is about when it puts together the repertoire of characteristics that marks a species.

### The Urge To Take Charge of Nature

Lately, however, some distinguished champions of bio-engineering have started to tell a different story, claiming that this whole idea of firm divisions among species is out of

date. Not only (they say) can some characteristics be moved about among species, but there is no reason in principle why all characteristics should not be so moved. Species are not serious entities at all, but merely fluid stages on a path along which organisms can always be shifted and transformed into one another. This transformability is called *algeny* --a name modeled on alchemy but this time (it is claimed) not a mistake but a genuine advance. (The name has not been devised as a joke by outside critics. It comes from Joshua Lederberg, a Nobel laureate biologist and past president of Rockefeller Univer-

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sity who is a powerful champion of bio-engineering.<sup>3</sup>)

Algenists propose, then, that just as the alchemists thought of all chemical substances as merely stages on an unbroken continuum, so biologists should see living species as stages on a continuum along which, in principle, they can always be moved and exchange their properties. As in alchemy, this process has a direction, the word *alchemy* itself being apparently derived from an Arabic word for "perfection." For the alchemists, all metals were in the process of becoming gold. Alchemists saw themselves as midwives accelerating this natural process of improvement. And, notoriously, this was for them not just a commercial enterprise but also a mystical and religious one. When Meister Eckhart wrote that "copper is restless until it becomes gold"<sup>4</sup> he was speaking figuratively of the soul's struggle for salva-

tion--a way of thinking that still impressed Newton.

In the same way today, the mystics of the genetic revolution see themselves as experts engaged in completing nature's work and especially in the business of ultimately perfecting humanity. As Robert Sinsheimer puts it,

The old dreams of the cultural perfection of man were always sharply constrained by his inherited imperfections and limitations . . . . *The horizons of the new eugenics are in principle boundless* --for we should have the potential to create new genes and new qualities yet undreamed of . . . . Indeed this concept marks a turning-point in the whole evolution of life. For the first time in all time, *a living creature understands its origin and can undertake to design its future.* Even in the ancient myths man was constrained by essence. He could not rise above his nature to chart his destiny. Today we can envision that chance--and its dark companion of awesome choice and responsibility.<sup>5</sup>

These transformations are seen as being quite straightforward. Thus Thomas Eisner writes,

As a consequence of recent advances in genetic engineering, [a biological species] must be viewed as . . . a depository of genes that are potentially transferable. A species is not merely a hard-bound volume of the library of nature. It is also a loose-leaf book, whose individual pages, the genes, might be available for selective transfer and modification of other species.<sup>6</sup>

### Images of Alienation

What does this amount to? Scientifically, of course, the idea of separable leaves doesn't work. This language reflects an unusable view of genetics--so-called "bean-bag genetics" of the crudest kind: one gene, one

characteristic. From the metaphorical angle too, the implications of these pictures are not encouraging. The idea of improving books by splicing in bits of other books is not seductive because in books, as in organisms, ignoring the context usually produces nonsense. Nor is the parallel with the chemical elements, which is more seriously meant, any more hopeful. It is of course true that atomic scientists did, up to a point, confirm the alchemists' suspicion that it was possible to break the boundaries between elements. They broke them at Los Alamos and Hiroshima and on a number of other occasions since, for instance at Chernobyl. But these events did not generate any general recipe for breaking them safely and successfully. Nor did researchers discover that elements evince any general progress toward ultimate perfection, either in gold or in *Homo sapiens*.

Another more powerful image, however, still lurks in the background. It is the one constant suggested by the word "engineering": the simple analogy with machines. Cogs and sprockets can in principle be moved from one machine to another since they are themselves fairly simple artifacts, and both they and the machines they work in are more or less fully understood by their designers. Those who use this analogy seem to be claiming that we have a similar understanding of the plants and animals into which we might put new components. But we did not design those plants and animals. This is perhaps a rather important difference.

The really strange and disturbing thing about all these images is the alienation of the human operator from the system he works on. He appears as an extraneous critic, a fastidious reader, free to reshape books to suit his own taste, a detached engineer redesigning a car to his own satisfaction. Even when the book or car in question is a human body--per-

haps his own--this designer stands outside it, a superior being who does not share its nature. Readers can always get another book if they don't like the first one, and car-owners are not much surprised at having to get another car.

What sort of being, then, is this operator supposed to be? He (it surely is a he) can only be a Cartesian disembodied soul, a ghost in the machine. He "lives in his body" only in the sense in which a yachtsman might live in his boat. Like so much of the science-fiction that has influenced them, these images are irredeemably dualist, implying a quite unreal separation between ourselves and the physical world we live in. Today

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we are supposed to have escaped from Descartes' dualistic prison, but some of us don't even want to try to.<sup>7</sup>

#### Successive Technologies, Successive World Views

**H**ow seriously ought we to take these algenic manifestos? Need we really worry about their strange metaphors?

Of course not all bio-engineers sign up for this bizarre ideology, or want to. They may well not mean to speak or write in these terms. All the same, it surely does seem that they are often acting in such terms, whether consciously or not. The scale on which the whole work is going forward, the colossal confidence expressed in it, the way in which it distracts attention from other possible enterprises, the rate at which money flows into it, all seem to imply a be-

lief that its possibilities are unparalleled--potentially infinite. It is taken for granted that this is the best way to solve our problems. It is expected, quite generally, that social problems will have biochemical solutions.

This is surely what horrifies the objectors. What they are essentially rejecting is not any particular single project. It is this huge uncriticized impetus, this indiscriminate, infectious corporate overconfidence, this obsessive one-way channeling of energy. The speed and scale involved are crucial. Single projects, introduced slowly, tentatively, and critically, would not necessarily disrupt our whole idea of nature. We have got used to many such changes in human history. But it always takes time to learn to live with them, to get a realistic idea of their pros and cons, to fit new things into our lives without ruining them. It is already taking us a long time to do that with existing inventions such as contraception and rapid transport.

Anyone who doesn't think this kind of delay is necessary--anyone who wants people to rush with aplomb into this mass investment of mind and resources--does have to be calling for a drastically changed view of nature as a whole, a view which claims that our power and knowledge are such that we can rationally expect to alter everything. To feel this kind of confidence, we would need to stop thinking of the natural world as a colossal complex system with its own laws, a system that we, as a tiny part of it, must somehow try to fit into, and begin instead to see it simply as a consignment of inert raw material laid out for our use.

To say that this change is *unnatural* is not just to say that it is unfamiliar. It is unnatural in the quite plain sense that it calls on us to alter radically our whole conception of nature. Our culture has of course already moved a long way in the direction of making that shift, from Bacon's

trumpet calls in the seventeenth century to Hem-y Ford's in the twentieth. Of late, however, environmental alarms have sharply slowed that triumphalist movement, making us try to be more realistic about our own vulnerability and dependence. The ideology of algeny is clearly a step against that move toward realism.

In fact, our culture is at present trying to ride two horses here. It is poised uneasily between two views of nature. The confident, contemptuous Baconian view of nature already pervades many of our institutions, notably in intensive farming, where the feeding arrangements that produced mad cow disease are nothing exceptional. Market forces see to it that short-termism and institutionalized callousness already rule the way in which we rear animals for our food. Seeing this, proponents of bio-engineering sometimes ask why we should object to moving further in this direction. Doesn't consistency demand that we extend the conquest that we have begun?

Consistency, however, is notoriously not always a virtue, as the public is uneasily aware. The fact that you have cut off somebody's arm is not always a reason why you have to cut off his leg as well. It is one thing to have drifted into having faulty institutions that one doesn't yet see how to change. Deliberately adopting an ideology that entirely obscures what is bad about them is quite another.

That ideology is what really disturbs me, and I think it is what disturbs the public. This proposed new way of looking at nature is not scientific: it is not something that biology has shown to be necessary. Far from that, it is scientifically muddled. It rests on bad genetics and dubious evolutionary biology. Though it uses science, it is not itself a piece of science but a powerful myth expressing a determination to put ourselves in a relation of control to the nonhuman world around us--to be in the driving seat at all costs rather than attending to that world and trying to understand how it works. It is a myth

that repeats, in a grotesquely simple sense, Marx's rather rash suggestion that the important thing is not to understand the world but to change it. Its imagery is a Brocken specter, a huge shadow projected onto a cloudy background by the shape of a few recent technological achievements.

The debate then is not between Feeling, in the blue corner, objecting to the new developments, and Reason in the red corner, defending them. Rhetoric such as that of Sinsheimer and Eisner is certainly not addressed to Reason. It is itself an exuberant power fantasy, very much like the songs sung in the 1950s during the brief period of belief in an atomic free lunch, and also like those in the early days of artificial intelligence. The euphoria is the same. They are also partly motivated of course by the same hope of attracting grant money--just as the earlier alchemists needed to persuade powerful patrons that they were going to produce real, coinable gold.

But besides these practical considerations, in each case there is also a sincere excitement, a devout faith, a real sense of contacting something magical and superhuman. The magician becomes intoxicated with the thought that he is at last getting his hands on a power that lies near the heart of life.

This kind of exaltation has a significant history. In our culture it arose first in the seventeenth century, when theorists became fascinated by the burgeoning marvels of clockwork automata. This was the point at which technology began to shape the imagery by which people depicted their world and so to *dictate their metaphysic*--a process that continues and that has profound effects. On each occasion, prophets have gone far beyond the reasonable expectation of useful devices from the new form of work. Each time, they have used this new form to reshape their whole vision of the world, and of themselves, on the pattern of what was going on in their workshops.

In the case of clockwork, Descartes, Newton, and the eighteenth-century mechanists managed to shape a powerful vision that displayed the whole material world as one vast clock, claiming that the right way to understand any part of it was simply to find its "mechanism"--that is, the part of the machine that drove it. The cogs of this machinery were supposed to work always by direct physical impact. That imagery was so strong that when physicists themselves began to move away from it at the end of the nineteenth century, their attempt raised deep distress in the profession. Einstein and many others felt that rationality itself was threatened. And a general belief in this kind of clockwork undoubtedly remains today. We still talk of "mechanisms," and we are still not really happy about action at a distance, as in gravitation. And we are still using this language when we talk of "bio-engineering." But for the last century we have not been in a position to suppose, as Laplace did, that clockwork is literally the universal structure of the world.

### The Relevance of God

The difficulties of the physicists' shift from strict mechanism show up as a problem that cannot help recurring. How can people who see the world as a reflection of their current favorite technology handle the change from one technology to another? The status of a world view that revolves around a particular technology must vary with that technology's practical success and failure. Yet world views are expected to be permanent, to express timeless truths. Finality is expected when they are supposed to be religious and no less so when they are supposed to be scientific. The mechanistic picture was both religious and scientific. From the religious angle it did not, in its original form, mark any sharp break from the view that had preceded it, since God was still the designer. The

stars were still busy, as they were in Addison's hymn,

*For ever singing as they shine*

*"The hand that made us is divine's*

This ambiguity was what enabled the pattern to catch on so widely, allowing the general public to accept Pope's celebration of it

*Nature and Nature: laws lay bid in night,*

*God said "Let Newton be" and all was light.<sup>9</sup>*

On the clockwork model the world thus became amazingly intelligible. God, however, gradually withdrew from the scene, leaving a rather unsettling imaginative vacuum. The imagery of machinery still survived, but where there is no designer the whole idea of mechanism begins to grow incoherent.

Thus there arose the gap that hopeful biotechnicians now elect themselves to fill. They see that mechanistic thinking requires a designer, and they feel well qualified to volunteer for this vacant position. That willingness stands out clearly from the words I have emphasized in Sinsheimer's proposal that "the horizons of the new eugenics are in principle boundless--for we should have the potential to create new genes and new qualities yet undreamed of. . . . For the first time in all time *a Living creature* understands its origin and can undertake to design its future."

Which living creature? It cannot be the human race as a whole; they wouldn't know how to do it. It has to be the elite, the biotechnologists who are the only people able to make these changes. So it emerges that members of the public who complain that biotechnological projects involve *playing God* have in fact understood this claim correctly. That phrase, which defenders of the projects have repeatedly dismissed as mere mumbo jumbo, is actually a quite exact term

for the sort of claim to omniscience and omnipotence on these matters that is being put forward.

The God-shaped hole in question has, of course, been causing trouble for some time. After the triumphal Newtonian spring, physics got increasingly complicated, to the point that J.C. Squire revised Pope's epiphany, complaining that

*It could not last; the Devil bowling "Ho!"*

*"Let Einstein be!" restored the status quo.<sup>10</sup>*

At this point a new world picture ought to have emerged, a picture drawn, this time, not from technolo-

*Playing God is actually a quite exact term for the sort of claim to omniscience and omnipotence that is being put forward.*

gy but from science itself. But, as Squire said, the public found these new physical theories so obscure that nobody managed to express them in a convenient image. The idea of "relativity" only generated a social myth, a vague cultural relativism about human affairs. Not till after the Second World War did three new and much more colorful images emerge in rapid succession. They all reached the general public, and they were all reflections of new technologies. They are the ones that occupy us today.

First, at the physical level, the idea of the atom was dramatized by bombs and by the promise of atomic power, so that the world seemed to consist essentially of atoms. Second, in human social life, computers emerged, and it was promptly explained that everything was really information. And third, on the biological scene, genetic determinism appeared, declaring that (among living

things at least) everything was really genes and we were only the vehicles of our genes, but that (rather surprisingly) we nevertheless had the power to control them.

It has proved quite hard to relate these three different world pictures, all of them reductive, but requiring different reductions. In theory, of course, they should not conflict. As far as they are scientific, they should, properly speaking, all find their modest places within the wider field of science. But world pictures like this are not primarily science. The science that is supposed to justify them is quite a small part of their content. They are actually metaphysical sketches, ambitious maps of how all reality is supposed to work, guiding visions, systems of direction for the rest of our ideas. And because these visions draw their strength from particular technologies in the outside world, belief in them fluctuates with the success of their parent technology and particularly with its disasters.

The news of Three Mile Island and Chernobyl took much of the steam out of the atomic myth. Though atoms are still there, people do not turn to them today for salvation. Bio-engineering has not yet had a similar disaster; if it did, the consequence would surely be the same. As for artificial intelligence, hard experience has cut back many of the claims that were made in its early days. At present, computers are still becoming more and more central in our lives and the metaphysical notion that "everything is really information" gains strength with acceptance of them. Thus today nobody is surprised to read in a book written by two (otherwise respectable) cosmologists the following strange jumble of metaphysical claims:

An intelligent being--or more generally, any living creature--is fundamentally a *type of computer*  
. . . A human being is a *program*



designed to run on a particular hardware called a human body . . . . A living human being is a *representation of a definite program*.<sup>11</sup>

Thus in a way that is surely very remarkable, our technology and our economics combine to shape our world view. As Jeremy Rifkin reasonably points out:

Every new economic and social revolution in history has been accompanied by a new explanation of the creation of life and the workings of nature. The new concept of nature is always the most important strand of the matrix that makes up any new social order. *In each instance, the new cosmology serves to justify the rightness and inevitability of the new way human beings are organizing their world by suggesting that nature itself is organized along similar lines . . . .* Our concepts of nature are utterly, unabashedly, almost embarrassingly anthropocentric . . . . The laws of nature are being re-written to conform with our latest manipulation of the natural world . . . . The new ideas about nature provide the legitimizing framework of the Biotech Century . . . . Algeny . . . is humanity's attempt to give metaphysical meaning to its emerging technological relationship with nature.<sup>12</sup>

### Mastered by a Technology

Of course technology is an important part of our life. Of course each new technology does teach us something about the world around us--often something very important. We can rightly draw from these lessons models to help us understand wider phenomena--so far as those models are actually useful.

The trouble only comes in with the obsession with a single model that drives out other necessary ways of thinking. The objectors are saying that the luminous fascination of bioengineering is making us constantly

look for biochemical solutions to complex problems that are not biochemical at all but social and political. For instance, much of the demand for liver transplants is due to alcohol. But it is a lot harder to think what to do about alcohol than it is to call for research on transplants. Similarly, infertility is largely caused by late marriage and sexually transmitted diseases. But changing the customs that surround these things calls for quite different and much less straightforward kinds of thinking. Again, food shortages throughout the world are caused much more by faulty systems of distribution than by low crop yields, and--in the opinion of most experienced aid agencies--the promotion of patented transgenic crops in poor countries is calculated to increase the faults in those distribution systems, not to cure them.

I touch on these examples briefly and crudely here, merely to show that objectors who are evidently moved by strong emotion are not necessarily being merely irrational and negative. My main aim throughout has been to point out the solid thoughts that may be found underlying this particular emotion and to suggest that--here as in other issues of policy--we had better take such thoughts seriously. Strong feeling no more tends to invalidate these contemporary protests than the equally strong feeling that accompanied early protests against slavery and torture invalidated those campaigns. In all such cases we need to understand what the excitement is about, not simply dismiss it.

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