Telos, Conservation of Welfare, and Ethical Issues in Genetic Engineering of Animals

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Abstract The most long-lived metaphysics or view of reality in the history of Western thought is Aristotle's teleology, which reigned for almost 2,000 years. Biology was expressed in terms of function or *telos*, and accorded perfectly with common sense. The rise of mechanistic, Newtonian science vanquished teleological explanations. Understanding and accommodating animal *telos* was essential to success in animal husbandry, which involved respect for *telos,* and was presuppositional to our "ancient contract" with domestic animals. *Telos* was further abandoned with the rise of industrial agriculture, which utilized "technological fixes" to force animal into environments they were unsuited for, while continuing to be productive. Loss of husbandry and respect for *telos* created major issues for farm animal welfare, and forced the creation of a new ethic demanding respect for *telos.* As genetic engineering developed, the notion arose of modifying animals to fit their environment in order to avoid animal suffering, rather than fitting them into congenial environments. Most people do not favor changing the animals, rather than changing the conditions under which they are reared. Aesthetic appreciation of husbandry and virtue ethics militate in favor of restoring husbandry, rather than radically changing animal *teloi.* One, however, does not morally wrong *teloi* by changing them—one can only wrong individuals. In biomedical research, we do indeed inflict major pain, suffering and disease on animals. And genetic engineering seems to augment our ability to create animals to model diseases, particularly more than 3,000 known human genetic diseases. The disease, known as Lesch–Nyhan's syndrome or HPRT deficiency, which causes self-mutilation and mental retardation, provides us with a real possibility for genetically creating "animal models" of this disease, animals doomed to a life of great and unalleviable suffering. This of course creates a major moral dilemma.

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Perhaps one can use the very genetic engineering which creates this dilemma to ablate consciousness in such animal models, thereby escaping a moral impasse.

Keywords Teleology · *Telos* · Mechanistic explanation · Animal husbandry · Genetic engineering · Transgenic animal models

Contents

1 Telos

Expressed in very simple terms, a metaphysics is a set of concepts in terms of which we understand the world; a frame through which we organize what we mean by reality. Far and away, the most long-lived metaphysics that ever held sway in the Western world is Aristotle's teleology, which saw the world and what took place in the world in terms of ends, functions, purposes and what Aristotle called final causes. This worldview reigned supreme in the Western world from the time of Aristotle until the scientific revolution of the seventeenth century, almost 2,000 years. In Aristotelian terms, biological organisms represented the model according to which all other organisms and processes in the physical world were to be understood. Just as was the case with living things, all natural and artifactual entities possessed a *telos*, or final cause or end or nature or purpose, which determined its function, and thereby its nature. Rather than biology being subsumed under mechanistic causation, efficient causes, even putatively "dead matter" had a nature or unique function by which it was to be explained. The function of a rock, for example, was, unless impeded, was to fall toward the center of the Earth, which was also the center of the universe. Hold a rock in your hand, and you feel it's tendency to move downward if all obstacles to such movements are removed.

The science of biology, for Aristotle, was very simply understanding how living things fulfilled the functions of any living thing—sensation, nutrition, locomotion, growth, and reproduction. The sum total of how an organism does so is constitutive of its *telos* or nature. Every living thing was to be explained in terms of how it fulfilled its *telos*. *Telos*, in modern terminology, is roughly what is encoded in an animal's genetics, as expressed in its normal environment—the pigness of the pig, the dogness of the dog, what common sense recognizes as "fish gotta swim; birds gotta fly."

The fact that nature was to be explained teleologically or functionally did not presuppose that the functions in question were consciously adhered to by an organism, or consciously designed, even though Aristotelian teleology was adopted by the Catholic Church to fit a theological purpose, namely that all of nature had been designed by God. We can explain the sharp edge of a knife by reference to what a knife does, namely cut, without assuming consciousness on the part of the knife. In a similar manner, we can explain the building of dams by beavers in terms of such dams increasing the likelihood of catching fish without assuming either that beavers have a conscious purpose in mind when they build, or that they were consciously designed to do so; evolution by natural selection is perfectly adequate as an explanation, especially of the latter.

Seeing the world in terms of functions and purposes, particularly seeing living things, is totally compatible with ordinary experience and a common sense view of the world. (For this reason, Aristotle is often viewed as the greatest philosopher of common sense.) But, in the seventeenth century, when both common sense and Aristotelian philosophy were challenged by the solidly mechanistic scientific revolution of Galileo, Descartes, and Newton, teleological explanations were dealt with a serious blow, at least as far as scientists and philosophers were concerned. As is well-known, Descartes strongly challenged the world shown to us by our senses, and assumed to be real by common sense. Less well known, but even more destructive to commonsense and teleological explanations was Spinoza's vicious (and ultimately unfair) attack on thinking in teleological terms. Since teleology was completely rejected by adherents of the scientific revolution, it significantly waned in importance in modern thought, except for the Catholic Church and other theologians.

Teleology, at the hands of these theologians became equated with what is today known as "intelligent design"—evidence of a superior power who planned the world in an intentional, carefully designed manner. While teleology certainly fits for explaining artifactual creations, that is not necessarily its role as an explanatory model. Consider the adrenal gland: from an explanatory perspective, the adrenal gland exists to alert the body, and prepare for "fight or flight." Suppose a human infant dies before the adrenal gland has a chance to function. It is still reasonable to explain its presence in the body in terms of that role, even if it is never, in fact, actualized. Similarly, with the reproductive system, it is there to effect reproduction, even if the person lives a celibate life, and never in fact even attempts to reproduce. The same holds of animal *telos*—a pig, for example, embodies a certain set of functions constitutive of its life as a pig, even if it dies at birth; a certain set of potentials, which are real and explanatory regardless of whether that set is ever actualized, to use Aristotle's clear principles. There is nothing mystical, or even theological, in invoking *telos* as the blueprint or template for a certain form of life, actualized or not. The fact that the Scientific Revolution restricted itself to mechanistic explanations is totally irrelevant to the question of the utility or coherence of teleological explanations. As we shall show, *telos* has recently emerged as an explanatory concept for animal ethics and for genetic engineering.

One may in fact, look at the situation in the following way: If one is scientifically oriented in the mechanistic, post-Renaissance sense, and thereby believes

with Descartes that biology is and should be reducible to the physics of particles, one may eschew functional or teleological explanations strictly in favor of mechanistic, efficient causes. On the other hand, those who view the world in terms of common sense, not only do have any problem with teleological causation, but actually are compelled to see the world that way. Imagine trying to have a pet dog living with you and not being able to say "He wants to go out." Historically, however, understanding our companion animals was of little significance compared to understanding agricultural animals. Domestication of animals is more than 10,000 years old, and understanding these animals' *telos* represents both a cause and an effect of domestication. We could never have domesticated them if we failed to understand at least the basics of their *telos*, and as we domesticated them, we changed their *teloi* to suit domestication, making them more docile and tractable, and more dependent on us.

2 Violation of *Telos*

For virtually all of the history of domestication (99 % plus), we successfully managed the animals we employed for food, fiber, work, and transport by understanding their natures and respecting their *teloi*, in what has been called "the ancient contract" between humans and the animals that made civilization possible. It is arguable that the development of human civilization was directly dependent on the creation of a secure and predictable food supply. Such a food supply freed people from the uncertainties and vagaries of depending on hunting and gathering, and enabled the establishment of communities. Predictability regarding food was assured by the development of both plant and animal agriculture, which operated synergistically. Cultivation of crops and plants secured human ability to depend on (barring catastrophes of weather) foods of plant origin, and on a steady and local source of animal feed. Animal agriculture, in turn, provided a source of labor for crop production, as well as a predictable reservoir of animal protein for human consumption. The secure food supply ramified in the ability to develop manufacturing, trade, commerce, and in Hobbes's felicitous phrase, the "leisure that is the mother of philosophy," construed in the broadest sense as speculative thought, science, technological innovation, art, and culture.

Presuppositional to the development of both agricultures was the concept of sustainability, i.e., assurance that the conditions and resources necessary to them were indefinitely renewable. As children, many of us learned about balanced aquariums. If we wished to keep a fish tank where the fish lived and we didn't want to keep tinkering with it, we needed to assure that the system in question was as close to a "perpetual motion" machine as possible, a system that required little maintenance because all parts worked together. That meant including plants that produced oxygen and consumed carbon dioxide, enough light to nourish the plants, or rather plants that thrived in the available light source, water that was properly constituted chemically, scavengers to remove wastes, and soon. When such a

system worked, it required minimal maintenance. If something were out of balance, plants and animals would die, and require constant replacement. The fish tank aims at being a balanced ecosystem, and thus represents a model of traditional approaches to cultivation of land, wherein one sought to grow plants that could be grown indefinitely with available resources, which conserved and maximized these resources, and which would not die out or require constant enrichment. Hence, the beauty of pastoral agriculture, where pasture nourished herbivores, and herbivores provided us with milk, meat, and leather, and their manure enriched the pasture land in a renewable cycle.

Cultivation of land evolved locally with humans. If one did not attend to the constraints imposed by nature on what and how much could be grown in a given region, the region would soon cease to yield its bounty, by virtue of salinization, or depletion of nutrients or overgrazing, or insect infestation. Thus, over time, humans evolved to, as one book put it, "farm with nature," which became, like animal husbandry, both a rational necessity and an ethical imperative. Local knowledge, accumulated over a long period of trial and error, told us how much irrigation was too much; what would not grow in given soils; what weeds left standing protected against insects; where shade and windbreaks were needed, and so on. Thus, accumulated wisdom was passed on—and augmented—from generation to generation, and was sustainable, i.e., required minimal tweaking or addition of resources. The genius of agriculture was to utilize what was there in a way that would endure. If the land did not thrive, you did not thrive. Traditional agriculture, then, was inherently sustainable; by trial and error over long period of time it evolved into as close to a "balanced aquarium" as possible.

Not surprisingly, precisely isomorphic logic applied to sustainability in animal production. The maxim underlying continued success in rearing animals was good husbandry, which represented a unified synthesis of prudence and ethics. Husbandry meant, first of all, placing the animals into the optimal environment for which they had been bred, and where they could maximally fulfill their *telos*—their physical and psychological needs and natures. Having done so, the husbandman then augmented animals' ability to survive and thrive by watching over them—by providing protection from predators, food during periods of famine, water during times of drought, shelter during extremes of climate, assistance in birthing, medical attention, and generally ministering to whatever needs the animals had. So powerfully ingrained was this imperative in the human psyche, that when the Psalmist searches for a metaphor for God's ideal relationship to human beings, he can do no better than seizing upon the conceit of the Good Shepherd. The Shepherd serves as far more than merely a herdsman, but more as a guardian and protector of the sheep under his aegis:

> The Lord is my shepherd; I shall not want
> He maketh me to lie down in green pastures.
> He leadeth me beside the still waters.
> He restoreth my soul. (Psalm 23)

We want no more from God than what the Good Shepherd provides for his flock. As we know from other passages in the Old Testament, a lamb on its own would live a miserable, nasty, and short life by virtue of the proliferation of predators—hyenas, raptors, wolves, bears, lions, foxes, jackals, and numerous others. With the care and ministrations of the Shepherd, the animal lives well until such time as humans take its life, in the meantime supplying us with milk, wool, and in the case of some domestic animals, the labor that became indispensable to the working of land for crops.

The power of this symbiotic image cannot be overestimated in the history of Western civilization. In Christian iconography, for thousands of years, Jesus is depicted both as Shepherd and as lamb, a duality built into the very foundations of human culture. The pastor, a word harking back to pastoral, tends to his flock; the members of his congregation are his sheep. And when Plato discusses the ideal political ruler in the Republic, he deploys the shepherd-sheep metaphor: The ruler is to his people as the shepherd is to his flock. Qua shepherd, the shepherd exists to protect, preserve, and improve the sheep; any payment tendered to him is in his capacity as wage-earner. So too the ruler, again illustrating the power of the concept of husbandry on our psyches.

Animal agriculture was indispensable to the subsequent development of society and culture. Husbandry agriculture is the ancient contract that was presuppositional to that entire evolutionary process. In one of the most momentous ironies in the history of civilization, this ancient contract with the animals, as well with the Earth, in terms of sustainability, contained within it the seeds of its own undoing. It was in virtue of a secure and predictable food supply that humans could proceed with trade, manufacturing, invention, and the general flourishing of culture.

By the late nineteenth century, industrial proliferation and innovation had reached a point where sustainability and good husbandry seemed to be no longer essential presuppositions of civilization. The ancient contract, which we may characterize as husbandry with regard to animals, and stewardship with regard to the land, was the presuppositional bedrock upon which economics, art, and culture rests. Yet, with the profound hybrids of an Icarus who challenged inherent human limitations, with blind and abiding faith in the humanly crafted tools which repeatedly show themselves as impotent in the face of natural disaster, we thumbed our noses at both morality and prudence. As the ancients crafted the tower of Babel, so we began to overreach the constraints imposed on us by the natural world. In both crop and animal agriculture, the ancient values of sustainability, stewardship, and husbandry inexorably gave way to modernist values of industrialization, productivity, and efficiency. The symbiotic partnership between humans and the Earth, and between humans and animals, was rapidly transmuted into patent exploitation with no respect or attention to what priceless elements were lost.

The coming of the Industrial Revolution gave us the tools to break our husbandry contract with domestic animals. No longer were we helping the animals fit into the natural environment for which they were adapted. The values of good husbandry, and coexistence with animals for mutual benefit were, as soon as

possible, replaced by an overwhelming emphasis on productivity and efficiency. No longer did the animals' *telos* need to fit in the environment. Technology gave us the ability to force animals into deleterious environments that did not fit their *teloi*, and thus greatly damaged their welfare, but at the same time, did not affect their productivity. The happy unity of animal welfare and productivity was rendered asunder, with animals forced to remain productive while losing any chance of a good life. Consider any aspect of industrialized agriculture. Traditionally, if one crowded thousands of animals into high confinement, the animals would have sickened and died, and the producer would likewise have suffered. But, with the advent of technological manipulations, we could force animals into environments where they did not fit, without loss of productivity. The need for agriculturalists to understand animal natures in order to ensure both welfare and productivity disappeared with the advent of antibiotics, vaccines, air handling systems, hormones, all of which severed welfare from productivity. Understanding *telos*, historically presuppositional to agricultural success, ceased to matter.

As long as respect for *telos* made animal agriculture possible, there was little need for an ethic of animal welfare. For, if one failed to respect animal nature, the animals failed to produce. The only ethic extant was a prohibition of deliberate, intentional, sadistic, purposeless, and deviant cruelty. If society wished to preserve fair treatment of animals in the face of relentless industrialization, an articulated ethic for animal treatment to guide behavior, a new ethic was required, one that would preserve and restore the proper treatment of animals presuppositional to good husbandry.

3 A New Ethic for Animals Based in Telos

Various philosophers proposed different approaches to creating a new ethic. Most noteworthy, perhaps, was Peter Singer's attempt to deduce a new ethic for animals from Utilitarianism (Singer 1975), the theory based on maximizing pleasure and minimizing pain, and creating "the greatest happiness for the greatest number." While ingenious and compelling, there were problems in Utilitarianism, which rendered it unacceptable to many people. In particular, it seemed artificial to express all the harms we do to animals, from removing their babies too early; to keeping social animals isolated from conspecifics; to depriving them of the ability to move or forage; to performing surgery on them with no anesthesia or analgesia; to stressing and frightening them in transport; to beating them; to preventing them from utilizing the natural powers they have evolved to survive, along a simple quantitative spectrum of pleasure and pain. The second problem arises from what is famously known as "the tyranny of the majority," the fact that Utilitarianism seems to allow the good of the majority to outweigh basic interests of the minority. We will return to this point.

The resurrection of the concept of *telos* was largely accomplished by this author in his attempt to create an animal ethic not subject to the criticisms directed at

Utilitarianism (Rollin 2006a, b, 2011a, 2013). In my view, any successful ethic for animals had to compel acquiescence from virtually everyone in society, who would see it as a consequence of beliefs they already held. I based this position on a point insisted upon by Plato, namely in order to convince people of ethical ideas, one needed to *remind*, not to *teach* (Rollin 2011b). This strategy was in turn developed by Martin Luther King, who realized that all Americans would accept two ethical premises fundamental to US government: (1) All humans were entitled to be treated as equals and (2) Black people were humans. Segregationists had just not bothered to draw the conclusion. If the conclusion was "written large" as Plato said, people would "recollect" and acquiesce to it.

In my reasoning, I argued that what we did to animals mattered to them, and that such mattering was best expressed in terms of violating their nature or *telos*. Furthermore, the ethical theory underlying American democracy was a blend of Utilitarianism, and protection of individuals who might be in the minority on certain issues. Certainly, in the USA and other democratic societies, we make our social decisions by reference to the benefit of the majority. But, we protect individuals in the minority by building protective fences around their human nature, or *telos,* as characterized in the Bill of Rights. Humans are beings who wish not to be tortured, to express themselves freely, to worship as they wished, to assemble with like-minded others, to hold onto their possessions. These basic human desires are protected by rights, which serves as a check on unbridled Utilitarianism.

It is part of normal common sense to view animals as having natures, the "pigness of the pig," the "dogness of the dog." And common sense recognizes the need to respect animal *telos*; "fish gotta swim, birds gotta fly." Given the basic ethic built into society, we ought to protect the fundamental interests of animals from encroachment. As I was told once in 1980, in the course of addressing all Canadian government ministers whose brief included animals, "we need a Bill of Rights for animals." Furthermore, common sense is quite capable of identifying fundamental aspects of animal nature. Ordinary people know full well that cows belong on pasture not concrete; that pregnant sows do not belong in cages. (Smithfield Farms, the world's largest swine producer, acknowledged this and announced their abandonment of gestation crates when they surveyed their customers at my suggestion and found that 78 % unequivocally rejected such high confinement.) And the public in Europe and the USA has further shown their willingness to encode such respect for animal nature in law if it no longer follows naturally from good husbandry.

My account of the emerging societal ethic for animals, based in our universally accepted ethic for humans, seems to capture some fundamental features of social thought. And the concept of *telos* is a foundational concept of that ethic. Granting that respect for animal nature or *telos* is a critical part of animal ethics, what does that ethic tell us about changing *telos* with the advent of genetic engineering? Unfortunately, a number of writers in this area have concluded that basing animal ethics on *telos* means that genetic engineering is inherently wrong with regard to animals. This may be true on some interpretations of *telos*, but emphatically not on my common sense version. In the Catholic tradition, and in the biblical account,

animal nature is permanent, fixed, immutable, and set by God. On the other hand, the notion of *telos* we have explained is perfectly compatible with what biology tells us. An animal's nature is a snapshot of a constantly dynamic, developing process of evolution. There is nothing prima facie wrong in itself with humans participating in that process, as we have done with domestication. It is estimated that 70 % of grasses and 40 % of flowering plants represent new species created by humans through hybridization, cultivation, preferential propagations, and other means of artificial selection. So, as I have extensively argued, there is nothing *intrinsically* wrong with genetically engineering animals.

I have asserted that, given an animal's *telos*, and the interests that are constitutive thereof, one should not violate those interests. I never argued that a given *telos* itself could not be changed. If the animals could be made happier or less miserable by changing their natures, I see no moral problem in doing so (unless, of course, the changes harm or endanger other animals, humans, or the environment). *Telos* is not sacred; what is sacred are the interests that follow from it.

4 Changing *Telos* to Avoid Suffering

Can one then use genetic engineering of *telos* as a remedy for the serious animal welfare issues that emerge from modern industrialization of agriculture or other animal uses? (Rollin 1995). Consider a case where one might indeed be tempted to change the *telos* of an animal chickens kept in battery cages for efficient, high-yield egg production. It is now recognized that such a production system frustrates numerous significant aspects of chicken behavior under natural conditions, including nesting behavior, and that frustration of this basic need or drive results in a mode of suffering for the animals. Let us suppose that we have identified the gene or genes that code for the drive to nest. In addition, suppose we can ablate that gene or substitute a gene (probably *per impossibile)* that creates a new kind of chicken, one that achieves satisfaction by laying an egg in a cage. Would that be wrong in terms of the new ethic I have described?

If we identify an animal's *telos* as being genetically based and environmentally expressed, we have now changed the chicken's *telos* so that the animal that is forced by us to live in a battery cage is satisfying more of its nature than is the animal that still has the gene coding for nesting. Have we done something morally wrong? I would argue that we have not. Recall that a key feature, perhaps the key feature of the new ethic for animals I have described, is a concern for preventing animal suffering and augmenting animal happiness, which I have argued involves satisfaction of *telos*. One can also argue that the primary, pressing concern is the former, the mitigating of suffering at human hands, given the proliferation of suffering that has occurred in the twentieth century. I have also argued that suffering can be occasioned in many ways, from infliction of physical pain to prevention of satisfying basic drives. So, when we engineer the new kind of chicken that prefers laying in a cage and we eliminate the nesting urge, we have removed a

source of suffering. Given the animal's changed *telos*, the new chicken is now suffering less than its predecessor and is thus closer to being happy, that is, satisfying the dictates of its nature.

Mill asks "is it better to be a satisfied pig or a dissatisfied Socrates?" His response, famously inconsistent with his emphasis on pleasure and pain as the only morally relevant dimensions of human life, is that it is better to be a dissatisfied Socrates. In other words, we intuitively consider the solution to human suffering offered, for example, in *Brave New World,* where people do not suffer under bad conditions because they are high on drugs, to be morally reprehensible, even though people feel happy and do not experience suffering. Why then, would we consider genetic manipulation of animals to eliminate the need that is being violated by the conditions under which we keep them to be morally acceptable?

This is an interesting and important objection, amenable to a number of different responses. Let us begin with the *Brave New World* case. Our immediate response to that situation is that the repressive society should be changed to fit humans, rather than our doctoring humans (chemically or genetically) to fit the repressive society. It is, after all, more sensible to alter clothes that do not fit than to perform surgery on the body to make it fit the clothes. And it is certainly possible and plausible to do this. So we blame the *Brave New World* situation for not attacking the problem.

This is similarly the case with the chickens. We know that laying chickens lived happily and produced eggs under conditions where they could nest for millennia. It is our greed that has forced them into an unnatural situation and made them suffer—why should we change them, in order to succumb to greed? This seems to be a simple point of fairness.

A disanalogy between the two cases arises at this point. We do not accept any claim that asserts that human society must be structured so that people are totally miserable unless they are radically altered or their consciousness distorted. Given our historical moral emphasis on reason and autonomy as nonnegotiable ultimate goods for humans, we believe in holding on to them, come what may. Efficiency, productivity, wealth—none of these trump reason and autonomy, and thus the *Brave New World* scenario is deemed unacceptable. On the other hand, were Mill not a product of the same historical values but was rather truly consistent in his concern only for pleasure and pain, the *Brave New World* approach or otherwise changing people to make them feel good would be a perfectly reasonable solution.

In the case of animals, however, there are no ur-values like freedom and reason lurking in the background. We, furthermore, have a historical tradition as old as domestication for changing (primarily agricultural) animal *telos* (through artificial selection) to fit animals into human society to serve human needs. We selected for nonaggressive animals, animals that depend on us not only on themselves, animals disinclined or unable to leave our protection, and so on. Our operative concern has always been to fit animals to us with as little friction as possible—as discussed, this assured both success for farmers and good lives for the animals. If we now consider it essential to raise animals under conditions like battery cages, it is not

morally jarring to consider changing their *telos* to fit those conditions in the way that it jars us to consider changing humans.

Why then does it appear to some people to be prima facie somewhat morally problematic to suggest tampering with the animal's *telos* to remove suffering? In large parts, I believe, because people are not convinced that we can't change the conditions rather than the animal. (Most people are not even aware how far confinement agriculture has moved from traditional agriculture. A large East Coast chicken producer for many years ran television ads showing chickens in a barnyard and alleging that he raised "happy chickens.") If people in general do become aware of how animals are raised, as occurred in Sweden and later all over Europe, and as animal activists are working to accomplish here, they will be in doubtless demand, just as the Swedes did, first of all a change in raising conditions, not a change in the animals.

On the other hand, suppose the industry manages to convince the public that we cannot possibly change the conditions under which the animals are raised or that such changes would be outrageously costly to the consumer. And let us further suppose that people still want animal products, rather than choosing a vegan lifestyle. There is no reason to believe that people will ignore the suffering of the animals. If changing the animals by genetic engineering is the only way to assure that they do not suffer (the chief concern of the new ethic), people will surely accept that strategy, though doubtless with some reluctance.

From whence would stem such reluctance, and would it be a morally justified reluctance? Some of the reluctance would probably stem from slippery slope concerns—what next? Is the world changing too quickly, slipping out of our grasp? This is a normal human reflexive response to change—people reacted that way to the automobile. The relevant moral dimension is consequentialist; might not such change have results that will cause problems later? Might this not signal other major changes we are not expecting?

Closely related to that is a queasiness that is at root aesthetic. The chicken sitting in a nest is a powerful aesthetic image, analogous to cows grazing in green fields. A chicken without that urge jars us. But when people realize that the choice is between a new variety of chicken, one without the urge to nest and denied the opportunity to build a nest by how it is raised, and a traditional chicken with the urge to nest that is denied the opportunity to build a nest, and the latter is suffering while the former is not, they might well accept the removal of the urge, though they are likelier to be reinforced in their demand for changing the system of rearing and, perhaps, in their willingness to pay for reform of battery cages.

The most significant justified moral reluctance would probably come from a virtue ethic component of morality. Genetically engineering chickens which no longer want to nest could well evoke the following sort of musings: "Is this the sort of solution we are nurturing in society in our emphasis on economic growth, productivity, and efficiency? Are we so unwilling to pay more for things that we do not hesitate to change animals that we have successfully been in a contractual relationship with, since the dawn of civilization? Do we really want to encourage a mind-set willing to change venerable and tested aspects of nature at the drop of a

hat for the sake of a few pennies? Is tradition of no value?" In the face of this sort of component to moral thought, I suspect that society might well resist the changing of *telos*. But at the same time, people will be forced to take welfare concerns more seriously and to decide whether they are willing to pay for tradition and amelioration of animal suffering, or whether they will accept the "quick fix" of *telos* alteration. Again, I suspect that such musings will lead to changes in husbandry, rather than changes in chickens—"raise the bridge, don't lower the river."

Some people have argued that my suggestion for changing chickens "degrades and diminishes the *teloi* found in the world." In my discussions of what sorts of genetic engineering of animals are morally acceptable, I have argued for what I call "the principle of conservation of welfare," (Rollin 1995) a moral principle that asserts that genetically engineered animals should be no worse off in terms of welfare than the parent stock from whence they have been derived. It might appear to my critics that my idea for ablating from the chicken genome many of the interests we fail to meet in modern agriculture is in stark violation of this principle, since the engineered chickens have an impoverished *telos.* This would constitute a logical error. The welfare I insist be conserved is that of the *individual* chickens, animals which suffer considerably if they retain the traditional chicken *telos.* The *telos* itself does not have welfare, or non-welfare. Thus, "simplifying" the chickens' nature to avoid suffering does not create negative welfare or suffering; in fact it *ablates* suffering by removing the conflict between the animals' lives and their natures. One can certainly adopt a metaphysical perspective, affirming that the more complex the *teloi*, the better the world, but that would be difficult indeed to argue in the face of considerable suffering accompanying greater complexity, and difficult to argue without invoking theology. At best, the objection raised against me is an aesthetic one, claiming that a simplified universe is an uglier universe. I would respond by acknowledging this point, but also arguing that suffering of sentient beings is far more morally reprehensible than ugliness. (In any case, there will always as a matter of fact be those consumers who demand the traditional chicken, even as a small number of people buy "heritage turkeys" at hugely inflated prices, thereby preserving the *telos* in question, albeit with far fewer instances.)

In any case, attributing qualities that apply to individual *teloi* to the generic concept of *telos* represents a classic logical fallacy, *the fallacy of division*. Just because mammals have hair and give milk does not mean that the concept of "mammal" has hair and lactates. In fact, of course, it does not.

Using genetic engineering to fix the welfare problems emerging from the industrialization of agriculture, as discussed with regard to the poultry industry, seems to be, as we saw, an unnecessary self-indulgence, as we raised poultry for eons with great success by respecting their *telos*, rather than modifying it for what essentially amounts to reasons of expediency resulting from greed and selfishness rather than necessity. When we attend to biomedical uses of animals in experimentation, we confront a far more difficult problem. In the research area, the purpose of the enterprise is to ameliorate and eliminate human (and animal)

suffering resulting from disease, be it environmental, microbial, or genetic. It is for this reason that the research community has long sought animal models for disease conditions. But this project generates a fundamental ethical dilemma that emerges from biomedical science, namely what entitles us to create disease, with attendant severe pain, suffering, and distress in primordially innocent animals? Even if the research is aimed at benefiting other animals, it is difficult rationalizing causing misery in Peter in order to cure Paul.

Historically, the response to this ethical problem is to ignore it, or minimize its significance by stressing the absolute and unequivocal value and meaning of human life over that of animals, generally by invoking theological justifications. But recent cultural history and moral thinking has cast a shadow of doubt upon this facile justification. Fifty years of the development of animal ethics has provided good reason to doubt human superiority as a trump card. In addition, this ethical reasoning has also undercut the convenient ideological maxims employed as a justification by scientists, namely that "science is value-free in general, and ethics-free in particular," and that science must be agnostic regarding the presence of consciousness in animals, including pain and suffering (Rollin 2006b). In the face of recent progress by both ethicists and scientists in explicating animal mind, thoughts, and feelings, as well as exponential growth in societal ethical concerns about animal treatment, the denial of subjective experience in animals can no longer be utilized as a justification for hurting them.

The response to these recent realizations has taken various forms. For one thing, the search for what Russell and Burch postulated as *alternatives to live animals,* Replacement, Reduction, and Refinement, has developed considerably but as yet remains very limited as regards eliminating animal use by substituting non-animal use. Most plausible and practicable have been *Refinements,* aimed at minimizing pain and suffering attendant upon animal use in research. These refinements have been driven by regulatory change, such as the mandates to control animal pain, embodied in the USA, the UK, EU regulations that have developed since the 1980s. In particular, one can cite proliferation of analgesic use in science. In 1982, a literature search I undertook for the U.S. Congress revealed only two papers covering analgesia in the scientific literature. Two years ago, the same search yielded almost 12,000 papers. But let us recall a number of caveats about analgesia. Most notably, analgesia does not *eliminate* pain. What it does do is raise the *pain tolerance threshold,* which is significantly different from eliminating pain altogether. While this is certainly a step toward mitigating the dilemma of invasive animal use, it is far from a complete answer.

At first blush, genetic engineering compounds the problem of invasive animal use entailed by animal research. This is because transgenic technology provides us with the potential for creating "animal models" of vast number of diseases and conditions hitherto not researchable on animals, in particular, genetic diseases. I am referring to the creation and maintenance of seriously genetically defective animals developed and propagated to model some human genetic disease. This was traditionally accomplished through identification of adventitious mutations and selective breeding. Transgenic technology allows for accomplishing the same goal far

more quickly, and in a far wider range of areas. Thus, one can, in principle, essentially replicate any human genetic disease in animals. And therein lies the major ethical concern growing out of transgenic technology in the research area. It is a true dilemma, because there are strong moral pulls on both sides of the issue.

A chapter in a book devoted to transgenic animals helps to focus the concern:

> There are over 3,000 known genetic diseases. The medical costs as well as the social and emotional costs of genetic disease are enormous. Monogenic diseases account for 10 % of all admissions to pediatric hospitals in North America….and 8.5 % of all pediatric deaths…They affect 1 % of all live born infants…and they cause 7 % of stillbirths and neonatal deaths…Those survivors with genetic diseases frequently have significant physical, developmental or social impairment….At present, medical intervention provides complete relief in only about 12 % of Mendelian single-gene diseases; in nearly half of all cases, attempts at therapy provide no help at all (Karson 1991).

This is the context in which one needs to think about the animal welfare issues growing out of a dilemma associated with transgenic animals used in biomedical research. On the one hand, it is clear that researchers will embrace the creation of animal models of human genetic disease as soon as it is technically feasible to do so. Such models, which introduce the defective human genetic machinery into the animal genome, appear to researchers to provide convenient, inexpensive, and most important, high fidelity models for the study of the gruesome panoply of human genetic diseases outlined in the over 3,000 pages of text comprising the sixth edition of the standard work on genetic disease, *The Metabolic Basis of Inherited Disease.* Such "high fidelity models" may occasionally reduce the numbers of animals used in research, a major consideration for animal welfare, but are more likely to increase the numbers as more researchers engage in hitherto impossible animal research. On the other hand, the creation of such animals can generate inestimable amounts of pain and suffering for these animals, since genetic diseases, as mentioned above, often involve symptoms of great severity. The obvious question then becomes the following: Given that such animals will surely be developed wherever possible for the full range of human genetic disease, how can one assure that vast numbers of these animals do not live lives of constant pain, suffering, and distress? Further, given the emerging ethic we outlined above, control of pain and suffering is a *sine qua non* for continued social acceptance of animal research.

In today's moral ethos, it is simply not the case that any possible human benefits will outweigh any amount of animal suffering. If a genetic disease is rare, affects only small number of people, and can be prevented by genetic screening and what Kelley and Wyngaarden call in reference to Lesch–Nyhan's Syndrome "therapeutic abortion," (Kelley and Wyngaarden) it is not clear that society will accept the long term suffering of vast numbers of animals as a price for research on the disease. More and more, a cost-benefit mind-set is emerging vis à vis animal use in science just as it is legally mandated for research on humans—though it is by no means clear how one rationally weighs animal cost against human benefit!

In order to flesh out our discussion with a real example, let us examine the very first attempt to produce an animal "model" for human genetic disease by

transgenic means, i.e., the development by embryonic stem cell technology of a mouse which was to replicate Lesch–Nyhan's disease, or hypoxanthine-guanine phosphororibosyltransferase (HRPT) deficiency. Lesch–Nyhan's disease is a particularly horrible genetic disease leading to a "devastating and untreatable neurologic and behavioral disorder." Patients rarely live beyond their third decade, and suffer from spasticity, mental retardation, and choreoathetosis. The most unforgettable and striking aspect of the disease, however, is an irresistible compulsion to self-mutilate, usually manifesting itself as biting fingers and lips. The following clinical description conveys the terrible nature of the disease:

> The most striking neurological feature of the Lesch–Nyhan syndrome is compulsive self-destructive behavior. Between 2 and 16 years of age, affected children begin to bite their fingers, lips and buccal mucosa. This compulsion for self-mutilation becomes so extreme that it may be necessary to keep the elbows in extension with splints, or to wrap the hand with gauze or restrain them in some other manner. In several patients mutilation of lips could only be controlled by extraction of teeth.
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> The compulsive urge to inflict painful wounds appears to grip the patient irresistibly. Often he will be content until one begins to remove an arm splint. At this point, a communicative patient will plead that the restraints be left alone. If one continues in freeing the arm, the patient will become extremely agitated and upset. Finally, when completely unrestrained, he will begin to put the fingers into his mouth. An older patient will plead for help, and if one then takes hold of the arm that has previously been freed, the patient will show obvious relief. The apparent urge to bite fingers is often not symmetrical. In many patients, it is possible to leave one arm unrestrained without concern, even though freeing the other would result in an immediate attempt at self-mutilation.
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> These patients also attempt to injure themselves in other ways, by hitting their heads against inanimate objects or by placing their extremities in dangerous places, such as between spokes of a wheelchair. If the hands are unrestrained, their mutilation becomes the patient's main concern, and effort to inflict injury in some other manner seems to be sublimated (Kelley and Wyngaarden 1983).

At present, "there is no effective therapy for the neurologic complications for the Lesch–Nyhan's syndrome". Thus, Kelley and Wyngaarden, in their chapter on HPRT deficiency diseases, boldly suggest as alluded to earlier, "the preferred form of therapy for complete HPRT deficiency [Lesch–Nyhan's syndrome] at the present time is prevention," i.e., "therapeutic abortion." This disease is so dramatic that I predicted in 1976 that it would probably be the first disease for which genetic researchers would attempt to create a model by genetic engineering. Researchers have, furthermore, sought animal models for this syndrome for decades and have in fact created rats and monkeys which will self-mutilate by administration of caffeine drugs. It is thus not surprising that it was the first disease genetically engineered by embryonic stem cell technology. But to the surprise of the researchers, these animals, although they lacked the HPRT enzyme, were phenotypically normal and displayed none of the metabolic or neurologic symptoms characteristic of the disease in humans. The reason for the failure of this transgenic "model" has been suggested to be the presence of a backup gene for xanthine metabolism in mice, though other research has cast doubt on this notion. Though an asymptomatic mouse is still a useful research animal, for example to begin to test gene therapy, clearly a symptomatic animal would, as a matter of

logic, represent a higher fidelity model of human disease, assuming the relevant metabolic pathways have been replicated. Presumably too, it is simply a matter of time before researchers succeed in producing symptomatic animals—I have been told in confidence of one lab that seems to be close to doing so, albeit in a different species of animal. One may perhaps need to move up to monkeys to achieve replication of the behavioral aberrations.

The practical moral question which arises then is clear: Given that researchers will certainly generate such animals as quickly as they are able to do so, how can one assure that the animals live lives which are not characterized by the same pain and distress that they are created to model, especially since such animals will surely be used for long-term studies of the development of genetic diseases. Or should such animal creation be forbidden by legislation, the way we forbid multiple use of animals in unrelated surgical protocols in the U.S. or the British forbid learned helplessness studies?

There is, admittedly, no absolute or direct proof that U.S. society at least will reject the creation of such animals. The proof is indirect, based on George Gaskell's survey in Europe which morally rejected genetic engineering of animal models of disease (Gaskell 1997) and was also based on the incompatibility of creating such animals with the direction in which worldwide attitudes and laws regarding animal research are moving. At the very least, however, it would be prudentially unwise for the research community to forge ahead cavalierly with the creation of long term use of such animals. For, if U.S. attitudes are analogous to European ones, such proliferation of suffering animals could well evoke significant legislative restriction or even banning of any transgenic animal work, including the sort of work where lifelong suffering can be avoided by early endpoints, anesthesia, etc.

In a dialectical reversal worthy of Hegel or Marx, the very enterprise of genetic engineering that creates this difficult animal welfare problem, may contain within itself the seeds of the solution. Perhaps, one could, through the use of genetic engineering, create a nature for the genetically engineered animal model in which, similar to the case of the chicken discussed earlier, mentation in the Lesch–Nyhan animal could be eliminated to the extent that whatever symptoms are created in the defective animal, these symptoms no longer *matter* to the animal. In other words, however horrible the symptoms may be, they do not enter into the consciousness of the animals so designed. What would occur in the animal *telos* is rendering the animal functionally nonconscious. Since we are creating an animal where suffering is inevitable, removing consciousness, and thus removing the ability to suffer from its *telos*, does not violate our *principle of conservation of welfare*, since the Lesch–Nyhan animal has in essence been created to suffer, and removing that capability creates an animal with a *telos* meeting the human purpose for that animal devoid of the level of consciousness that makes its creation morally problematic. Even if, for all intents and purposes, this animal's *telos* renders it incapable of awareness, it is still constructed so as to enjoy a better life than it would if its experiences mattered to it in a significantly negative way.

Everything we have argued, of course, depends upon the assumption that the scientific community *will* create such defective and suffering animals in order to study human disease. But this seems to be a safe assumption, given the history of biomedical research. Here, of course, the motivation for creating such animals in the first place is far more laudable than the patent greed underlying the chicken example, in that what is primarily at stake is the elimination of human suffering, not additional profit. Clearly, if one is going to hurt animals for the benefit of humans, it is better that the ability to suffer on the part of those animals be ablated. Monstrous though this may appear at first blush, it still results in a better universe than if the animals *can suffer.*

The only question that remains is whether one could create such animals while they continue to serve as high fidelity models for the disease in question, since Lesch–Nyhans may indeed involve some element of consciousness in its very nature. On the other hand, there are a multiplicity of genetic diseases that do not involve consciousness whose study could benefit from the living but nonconscious animals we are postulating. Once again, the principle of conservation of welfare is not violated, as the *telos* of the animal rendered nonconscious should be compared to the conscious Lesch–Nyhans animal, whose life includes the defects generating suffering, not to a normal animal.

The modification of *telos*, by way of combining genetic engineering with behavioral neuroscience as a remedy for practices that cause pain or suffering by violation of *telos,* represents a whole new approach to intractable problems of animal welfare that emerge from contemporary animal use. Once the behavioral genetics of pain, fear, loneliness, distress, and other forms of suffering are understood, it is reasonable to expect that, in those cases where we insist on causing such suffering in pursuit of human benefit, one could transgenically remove either consciousness as a whole, or the ability to feel pain (such people are in fact born), or the particular mode of consciousness resulting from the animal need that is being violated, leaving the animal vegetatively alive but incapable of experiencing suffering as a result of the violation. It is an open question whether society will accept such radical changing of nature at human hands, as we discussed earlier, but it is also plain that society is likely to choose such a modality if the alternative is creating animals experiencing a lifetime of misery.

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