E – L O G O S
ELECTRONIC JOURNAL FOR PHILOSOPHY/2007
ISSN 1211-0442

‘Recombinant Nature’: Transgenics and the Emergence of Hum-animals

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Abstract
The advent of transgenic technologies have be a controversial area in science. For example critics argue that transgenics blurs the barrier between humans and animals. Another reason is that transgenics may diminish human belief of its superiority in the animal kingdom which has been asserted by various religious and philosophical worldviews. On the contrary, genetic research has brought to our attention of human similarity with the animal kingdom. The aim of this paper is to provide some philosophical understanding of transgenics and proffer new ways for exploring transgenics.

Introduction

The growth of new biotechnologies and their ability to ‘tinker with evolution’ has been a showpiece for science. In particular, genetic engineering has captured the attention of popular culture, due mainly to a plethora of sci-fi movies and programs which regularly depict genetically engineered societies and futures. The present ‘genetic mythos’ is sustained by a pan-mythic imagination which has for many millennia generated a litany of hybrid creatures – fusions of humans and animals (i.e harpies, centaurs, satyrs, minotaur, sphinx, mermaids, gorgons, hum-animal incarnations of Vishnu, totemic animals in indigenous societies). The symbolic representations of these fantastical creatures signified an “unnatural

disposition" (Karpowicz et al, 2005, p. 109) (see also Bazopoulou-Kyrkanidou 2001), the power of unbridled nature, and human connectedness with the non-human world.

Unsurprisingly, the biotechnological revolution in transgenics (recombitant DNA) has received considerable public and scholarly attention. The onus of this attention has tended to emphasise 'unmapped possibilities' of transgenics in relation to its defaults and benefits. For instance, in 1998 Jeremy Rifkin and Stuart Newman attempted to patent the 'humanzee' (part human, part chimpanzee transgenic) in protest of the apparent misuse of transgenic technologies. While Rifkin and Newman failed to patent the humanzee their protestation seemed to indicate a level of societal concern with the direction of transgenics.

Due to the plethora of opinions and arguments that are currently surrounding transgenics my analysis will locate transgenics in three sites: Transgenics and 'human dignity'; transgenics and taboo; transgenics and evolutionary enhancement. My aim is to assist our understanding via various philosophical concepts on the present debate on human to animal transgenics.

Transgenics and 'human dignity'

A discussion into the notion of human dignity in relation to human-animal transgenics demands an overview of the definitional and historical aspects of human-animal transgenics. The biological term for defining the combination of genetic material taken from two different species is called "chimera." In Greek mythology the chimera was a hybrid creature comprising the parts of a goat, lion, and snake. Greely (2003) examines various definitions of chimera which include one taken from the Oxford English Dictionary, meaning, "An

organism (commonly a plant) in which tissues of genetically different constitution co-exist as a result of grafting, mutation, or some other process." Karpowicz et al (2005, p. 109) state that the term "chimera" has been used to define “different branches of the biological sciences to describe inter- and intra-species combinations at many levels, from molecules, to cells, to whole organs.”

The creation of chimera began in the 1970’s. One of the first officially recognised chimera appeared “in 1974 when a simian virus was inserted into mice embryos, resulting in mice carrying this DNA” (Tri, 2003; Jaenisch & Mintz, 1974). This set the scene for various novel fusions such as the "Geep" that exhibits some of the characteristics of a goat and sheep (Polzin et al. 1987), and the transplantation of “quail brain into chicks, producing a creature with features of both (Karpowisz et al, 2005, p. 108; Balaban, Teillet, and Le Douarin 1988).

The successful creation of trans-animal chimera eventually led to the advent of human-animal chimera. Examples of human to animal chimera include the transplanting of “human neural stem cells into the forebrain of a bonnet monkey in order to assess stem cell function and development” (Robert & Baylis, 2003, p. 1). (See also Ourednik et al 2001). Recently, the Shanghai Medical University took a human skin cell from a person with motor neuron disease and injected it into rabbit eggs to produce early stage embryos, (Dennis, 2002; Sample, 2006), while scientists at Stanford University created a mouse which contains “human stem cells in its brain.” (Robert & Baylis, 2003, p. 1; Kreiger, 2002).

Some of the current transgenic applications of chimera are in the field of human life enhancement. These include:

1. The use of human to animal chimera for the harvesting of organs for xenotransplantation (Glen 2004).
2. Replacement of cartilage, heart valves, collagen tubes and cerebrospinal shunts (Glen 2004).
3. Skin, burns and wound healing.
4. Manufacture of transgenic milk for treatment of cystic fibrosis, phenylketonuria (PKU) and hereditary emphysema (Margawati 2005) (see also Emerging Technology Series 1997; Noor 1996).

Unsurprisingly, human to animal chimera opened a series of public debates into the ethical and moral viability of chimera per se. Public critics of new biotechnologies such as Jeremy Rifkin called for a ban on human to animal chimera. For Rifkin et al the creation of human to animal chimera is a biological bombshell. As Rifkin (2005) asserts:

> This time, we risk undermining our own species' biological integrity in the name of human progress. With chimeric technology, scientists now have the power to rewrite the evolutionary saga — to sprinkle parts of Homo sapiens into the rest of the animal kingdom as well as fuse parts of other species into our own genome and even to create new human subspecies and super-species. Are we on the cusp of a biological renaissance, as some believe, or sowing the seeds of our own destruction?

Rifkin's ban on human to animal chimera also includes "pharming" which uses transgenic animals for creating pharmaceutical drugs. Since the 1990's biotech companies have employed a range of recombitant DNA techniques, including animal cloning for producing drugs. The wide commercial use of pharming is verified by the 2006 GTC Biotheratpeutics report which states that there is an increasing market for factor Vlla for the treatment of

hemophilia, reported to be $845 million with future estimated sales to reach $2 billion by 2012 (GTC Biotherapeutics Reports Third Quarter 2006). The report also notes that rhFVlla which is a compound derivative of transgenic rabbit's milk could supply the future market place (GTC Biotherapeutics Reports Third Quarter 2006). Other transgenic derivative compounds from 'pharming' animals are given in the table below.

Table 2 Selected proteins from transgenic animals in the pipeline

Product (indication)	Development stage	Animal	Company
Recombinant human antithrombin III (ATIII) (hereditary deficiency of ATIII)	Phase 2/3 (US)	Goats	GTC Biotherapeutics (Framingham, MA, USA)
Human C1 esterase inhibitor (angioedema)	In Phase 2	Rabbits	Pharming (Leiden, The Netherlands)
Lactoferrin (antibacterial/antiviral)	Phase 1 completed	Cow	Pharming
α-glucosidase (Pompe disease)	Phase 2/3, but production shifted to Chinese hamster ovary cells	Rabbits	Pharming/Genzyme (Cambridge, MA, USA)
Bile salt–stimulated lipase (pancreatic insufficiency)	Phase 2 completed	Sheep	PPL Therapeutics
α-1 antitrypsin (pulmonary disease/ cystic fibrosis)	Phase 2 completed	Sheep	PPL Therapeutics/Bayer

Sources: Recombinant Capital and company websites *LD*

Table found in *Nature Biotechnology* 21, 839 - 842 (2003)
doi:10.1038/nbt0803-839 www.nature.com/nbt/journal/v21/n8/full/nbt0803-839.html

Intimated in Rifkin's critique of human to animal chimera is the notion of human dignity which points to the pre-eminence of human life, — the broad spectrum of human affectivity and its peculiar consciousness (Kass 2002, p. 18). Essentially, human dignity is based on the widespread belief that there is something unique and distinct in human beings which

validates their dignity from the rest of the animal kingdom. For Robert and Baylis (2003) human dignity alludes to concerns about how transgenic chimera might challenge the human community via their intentional creation (Johnstone & Eliot, 2003). In response to Robert & Baylis's argument, we may ask what makes a human life to merit worthiness? Here the assignation of human dignity becomes ambiguous (2005, p. 119). Similarly, John Harris (1998) argues that the notion of human dignity is unclear since it includes in its definition not using people to serve one's purposes (Karpowicz et al, 2005, p.119). One may argue here that the mode of capitalist production, especially its more predatorial forms, regularly diminishes human dignity.

Current ascriptions of human dignity have been largely influenced by Immanuel Kant who consigned human dignity to his thesis on moral law. (Hill, 1992, p.176). Kant maintained that human beings have an unconditional and unquestionable worth (*würde*) since they are moral and rational agents (Kant, 1964, p.94). In addition, Kant contended that human rationality is based on a series of distinctive capacities such as reason, aesthetic sensibilities, language, and culture, that cannot be assigned to a market value (Karpowicz et al, 2005, p.120).

> Human dignity is a widely shared notion that signifies that humans typically display certain sorts of functional and emergent capacities that render them uniquely valuable and worthy of respect (Karpowicz et al 2005, p. 120).

It is the collective nature of human capacities in relation to agency that is accorded equally to all human beings, regardless of a person's social station or state of physical and mental function (Karpowicz et al 2005, p. 120). In this way all human beings have an inherent individual

dignity (Pullman 2004) or what Aristotle coins as "*arête*," that is intrinsic to human dignity (Karpowicz et al 2005, p. 120).

It is on the point of human exceptionalism that ethologists have taken Kant and other humanists to task. Leading ethologist Marc Bekoff reminds us that there is an evolutionary continuity in human and non-human animals, with the latter also possessing culture, consciousness, self-cognizance, and empathy (Bekoff and Sherman 2004; Bekoff 2004 found in Bekoff, 2006, p. 81) Several decades of intensive research into animal behaviour reveal that aspects such as culture, language, tool using, and empathy are not unique to human beings. Primate studies indicate that bonobos (Hyat & Hopkins, 1994), chimpanzees (Gallup Jr.,1970), gorillas (Swartz & Evans, 1994) and orangutans (Miles, 1994; Lethmate & Dücker, 1973), know that they are seeing themselves in the mirror, suggesting an awareness of self (found in Ehrlich, 2000, p. 311). Extensive studies on bonobo behaviour indicate a complex behavioural repertoire which is cognate with human understandings of culture. Savage-Rumbaugh (1991), Savage-Rumbaugh et al (1998), and Sundberg (1996) have written on bonobo acquisition of human symbols as a way of enabling bonobos to communicate with human beings. Chimpanzees, bonobos, gorillas, and orangutans exhibit tool making behaviours, while chimpanzees and orangutans show cultural variations in tool using (de Waal, 1999; 2005; Whiten et al, 1999 found in Bekoff, 2006, p. 81, 86-87) (See also Van Schaik, 2006).

In relation to altruism in non-human animal behaviours, studies on co-meat and plant sharing among chimpanzees show levels of altruistic behvaviour (de Waal, 1989, p.433). (See also Pusey, 1983; Kane, 1980; Nishida, 1970; Silk, 1978, 1979, 1982; Kuroda, 1984. Lefebvre, 1982). Altruism is also evident in various non-primate species. African elephants for

example have been shown to assist weaker members. African elephants also "show higher levels of interest in the skulls and ivory of members of their own species than they do to natural objects or to the skulls of other large terrestrial mammals" (McComb, Baker, and Moss 2005 found in Bekoff, 2006, p. 87). The strong emotional bonds between elephants is demonstrated in a BBC Science report in November 2006 which revealed how Shirley and Jenny, two female elephants which were "introduced at the Elephant Sanctuary in Hohenwald, Tennessee," became highly emotional, "roaring loudly, touching one another and remaining in close contact, as if they were old friends - and they were, but no one else realised at the time." Later on, it became known to the staff that the two elephants "had lived in the same circus 22 years earlier, when Jenny was just eight years old and Shirley was thirty. (BBC, http://www.bbc.co.uk/nature/animals/features/246index.shtml).

Various ethological studies disclose levels of grief in non- human animals, thereby refuting Descartes claim that animals are "unfeeling automata" — incapable of feeling pain or emotions. Goodall (1990, p. 196-197), has reported grief exhibited by a chimpanzee called Flint after the death of his mother, Flo (Bekoff 2006, p. 84) while McConnery states that traumatised gorilla orphans die out of grief (found in McRae 2000, p. 86). Konrad Lorenz notes how goose grieve (Lorenz 1991, p. 251 found in Bekoff, 2006, p. 84). In 1996, The American Society for the Prevention of Cruelty to Animals (ASPCA) conducted a "Companion Animal Mourning Project."

> The study found that 36 percent of dogs ate less than usual after the death of another canine companion. About 11 percent actually stopped eating completely. About 63 percent of dogs vocalized more than normal or became more quiet. Study respondents indicated that surviving dogs changed the quantity and location of sleep. More than half

> the surviving pets became more affectionate and clingy with their caregivers. Overall, the study revealed that 66 percent of dogs exhibited four or more behavioral changes after losing a pet companion (Whitman http://www.friendsoftheanimals.com/articles.htm).

In light of these and other studies on non-human animal behaviour, our notions of human dignity need reassessing. This change in perspective may eventually allow human beings to act more ethically towards non-human animals.

Transgenics and Taboo

Since transgenics is posited on manipulating genetic material in ways which are not found in the natural world, the argument that transgenics is 'unnatural' or 'taboo' have been widely circulated. For example, Leon Kass (1997) suggests that unnaturalness or 'repugnance' provides a criterion for circumscribing a gamut of 'liminal' behaviours. In this way, the use of repugnance offers a method for defending core social values which are deemed to be under threat (Kass 1997, p. 20) (See also Karpowicz et al 2005, p. 110). Here the emotive responses against transgenics provide the impetus for its circumscription. As Kass notes: "Would anybody's failure to give full rational justification for his or her revulsion at these practices make that revulsion ethically suspect?" (Kass 2001, p. 6; 1997, p. 79). The unnaturalness proposal or what Streiffer (2003) subscribes to as "the yuk factor" is so entrenched in many societies that any deviation from it can evoke moral outrage and violence.

The argument that transgenics is based on violating species boundaries which would otherwise not exist is influenced by Aristotelian notions of *telos* (completion). According to Aristotle, each species has its own characteristics or *merkmal* which distinguishes it from

other species (Karpowicz et al 2005, p. 113). For all purposes the natural world is based on intrinsic principles which exhibit a kind of goodness (Karpowicz et al 2005, pp. 113-114). Consequently, the biological functioning of each species unfolds nature's principles which are deemed natural. That each species lives in accordance to its unique biological processes — its particular *entelechy* (teleology), is justification for its existence (Crowe 1977, pp. 192–245; d'Entreves 1970). Maintenance of the natural order, is therefore, a means of maintaining the moral good, as it would be morally wrong to alter the *telos* of a particular species (Karpowicz et al 2005, p. 114). Equally, the continuity between humans and non-human animals is pervasive for natural law theorists (Porter 1999). According to the natural law proponents, the transference of genetic material from humans to non-human animals and visa versa violates the teleology of those species concerned. (Karpowicz et al 2005, p. 114). However, the natural law argument is problematic as it ignores the fact that human beings are both products of evolution as well as innovators of it. The tinkering of evolutionary processes by human beings can be viewed as biological evolution acting via human purpose. Secondly, the natural law argument ascribes to the Aristotelian model of an unchanging universe that exists in accordance with its teleological design without interruption or deviation. The dilemma here is that nature adheres to the second law of thermodynamics which permits a degree of chaos in nature, even the unforeseen annihilation of species (as in the likelihood of global extinction events) making Aristotelian ascriptions of *telos* problematic.

Notions of unnaturalness and taboo have been given much theoretical attention by the anthropologist Mary Douglas. For Douglas (1969), human beings are creatures who live

according to social categories. Human societies use an array of complex social categories in order to maintain social order. Social categories are also important for delineating between socially sanctioned and prescribed behaviours. What is important here is that a taboo indicates a deviation from the 'natural' order of things which must be retrieved. In this way, a taboo is intrinsically tied to human ontology. Like Levi-Strauss (1978), Douglas maintains that an understanding of taboo laws must be viewed in reference to the 'structure of thought' in a society. In her famous essay of animal categories titled, "Abominations of Leviticus" (1969, pp. 41-57), Douglas contends that the subset of animals used by ancient Israelites were not about hygiene maintenance, but rather indicated symbolic boundaries (see also Stout 1988, pp. 145–62). Thus, an understanding of the Israelite construction of holiness is fundamental to either eating or avoiding a certain animal. Douglas avers that the Israelite conception of holiness was tied to notions of wholeness, not being mixed, and a state of not being separated. An animal which did not fit into a specific category, but rather crossed between two or more categories, thereby deviating from the natural order, was considered as polluting and banned from being eaten. Animals such as pigs and bats are 'non-kosher' for the reason that they do not conform to the natural order. For example, the pig is cloven hoofed like sheep and cows and suckles its young, but does not chew the cud. In the case of bats, they fly like birds but do not possess feathers nor lay eggs, and produce milk for their offspring. They also hang upside down unlike birds. In each case, the animal does not fit solely in an exclusive category.

However, the variability of animal taboo categories that are found in many western societies is not indicative of non-western societies. Apparently, many non-western societies are more

pre-occupied in establishing ties between humans and non-human animals. This is the case of Aboriginal Australians and other indigenous groups such as the African Mende people who claim to have descended from elephants. In some of these societies there is no moral prohibition against the mixing of humans and non-human animals. Similarly, the shamanistic penchant towards shape-shifting, whereby shamans are believed to have the power to turn into particular non-human animals, may be considered as the human concern with re-establishing communion with the non-human world (see Jackson & Karp 1990). For Karpowicz et al (2005, p. 111) there is a division between human societies which make sharp distinctions between humans and non-human animals and human societies which do not. It is probably safe to say that the former are characterised by systems of thought which are concerned with maintaining distinctions between humans and non-human animals, while the latter are more concerned with reaffirming the notion of 'sameness' between humans and non-human animals.

Transgenics and Evolutionary Enhancement

This section will discuss transgenics in relation to human evolutionary enhancements and will thereby be speculative in nature. The proposition that transgenics may alter human beings' cognitive and sensory capacities has been noted by Savulescu (2003) and Ehrlich (2000). For Savulescu, recombitant DNA between humans and nonhuman animals is a way of improving human cognition and sensory perception. Such biological enhancements will have wider social and health benefits. For example, future humanity may be able to reduce the rate of telomere degradation via recombining human genetic material with long lived animals such as the Galapagos tortoise or improve the human neuronal memory function by

transferring the gene responsible for long term memory in elephants (Savulescu 2003, p. 111). Moreover, the novel splicing of the owl or rabbit gene responsible for enhanced night vision in human beings may curtail night time road accidents and assist rescue teams (Savulescu 2003, p. 111).

Savulescu's thesis works within the ambit of transhumanism which encourages a technology driven biological enhancement of the human species (Bostrom 2003, 2005; Kurzweil 1999; Newman 2004). Transhumanist philosophers such as Nick Bostrom view the modern age as preparing human beings towards becoming post-human, with better all round cognitive and sensory abilities than present human beings (Bostrom 2003, p. 494). While transhumanism does not equate to utopianism it is indicative of a future vision in which genetic enhancement is a viable possibility. In transhumanist thought a transgenic posthuman has gone beyond human biological limitations and has the possibility of becoming another species of homo sapien (Lee 1997). Over a century ago H. G. Wells catapulted the idea of the transgenic posthuman in his book, *The Island of Doctor Moreau* (1896), in which a deranged scientist endeavours to make a 'perfect' human via non-human animals. Essentially, Moreau's collection of 'hum-animals' are dystopic creations that cannot remain human and are at the mercy of reverting to their former animal selves. The morale of the story is that the boundaries separating human beings and non-human animals should never be crossed.

An alternate transhumanist view is expressed by Paul Ehrlich (2000) who considers that transgenic humans may be more environmentally conscious because of their non-human sensory enhancements. If humans were able to see ultraviolet light, Ehrlich (2000, p. 328)

claims, they would be aware of the extent of the ozone layer depletion (see also Roan 1989). In addition, if humans had enhanced olfactory perception they would be more cognisant of the level of chemical pollutants in the atmosphere (Ehrlich 2000, p. 328) (see also Colborn et al 1996). Ehrlich's ecological transgenic human has evolved to accommodate to anthropogenic climate change.

A third approach which shares a correspondence with Savulescu and Ehrlich is Konstantin Khroutski's cosmist model which refers to an organism's ability to integrate with its surrounding environment (Modell 2006, p. 3) (see also Khroutski, 2006). In Khroutski's teleology human beings are at various levels of psycho-physical development with an aim of fulfilling their "ultimate health design" (Modell, 2006. p. 3; Khroutski 2006, p. 13). While Khroutski does not give detailed examples of his notion of "ultimate health design" I would argue that it includes a person's ability to evolve with the changing environment. Using Khroutski's cosmist model one could speculate the emergence of new kinds of transgenic humans in the future which have various physical characteristics for living in a world undergoing global warming. It is possible that in the future transgenic humans may possess a greater sense of connectedness with non-human animals due to their 'non-human enhanced sensory perceptions.' This in turn may lead to a new kind of ecological ethos which supplants non-ecological worldviews.

Conclusion

This paper has elucidated three areas of transgenics which have currency for the present and future. Notwithstanding the wide social protests against transgenics, it seems that transgenic

technologies will be an important showpiece of the bio-technological revolution in the 21st century. Whether transgenics can remain within ethical boundaries has yet to be determined, since this will be contingent on sociological factors. What is important in the transgenic debate is how people's constructions of non-human animals are often based on an anthropomorphic impasse. By this, I mean that non-human animals are deemed to be biologically inferior to human beings (by virtue of the Kantian idea of human dignity) and this informs human understandings of them. If Bekoff's study (2006) indicates anything it is that any assertion of human superiority based on human characteristics and abilities is scientifically refutable. As transgenic techniques advance into new areas which further blur the boundaries between human/non-human animals there will be a need to reformulate human ontology which is more inclusive with the non-human world.

References

Balaban, Evan; Teillet, Marie-Aimee; and Le Douarin, Nicole. (1988). Application of the quail-chick chimera system to the study of brain development and behavior. *Science* 241: 1339–42.

Baylis, Françoise,. Robert Jason Scott. (2006). *Primer on ethics and crossing species Boundaries*. http://www.actionbioscience.org/biotech/baylis_robert.html (accessed November 12, 2006).

Bazopoulou-Kyrkanidou, Euterpe. (2001). Chimeric creatures in greek mythology and reflections in science. *American Journal of Medical Genetics* 100: 66–80.

BBC, Science & Nature. November 15, 2006. http://www.bbc.co.uk/nature/animals/features/246index.shtml (accessed on December 5, 2006)

Bekoff. Marc. (2006). Animal passions and beastly virtues: cognitive ethology as the unifying science for understanding the subjective, emotional, empathic, and moral lives of animals. *Zygon* March 41 (1): 71-104.

Bekoff, Marc, & P. Sherman. (2004). Reflections on animal selves. *Trends in Ecology and Evolution* 19:176–80.

Bekoff, Marc. (2004). Wild justice and fair play: cooperation, forgiveness, and morality in animals. *Biology & Philosophy* 19:489–520.

Bostrom, Nick. (2005). A history of transhumanist thought. (Accessed on December 16, 2006 at http://www.nickbostrom.com/papers/history.pdf)

Bostrum, Nick. (2003). Human genetic enhancements: A transhumanist perspective. *Journal of Value Inquiry* 37 (4):493-506.

Colborn, T., D. Dumanoski, & J. P. Myers. (1996). *Our stolen future*. New York: Dutton.

Crowe, Michael. (1977). *The changing profile of the natural law*. The Hague: Martinus Nijhoff.

Dennis, C. (2002). China: stem cells rise in the East. *Nature* 419:334-36.

d'Entreves, Alexander P. (1970). *Natural law: An introduction to legal philosophy*, second revised edition. London: Hutchinson.

de Waal, Frans, B. M. (1989). Food sharing and reciprocal obligations among chimpanzees. *Journal of Human Evolution* 18 (5):433-459.

de Waal, Frans, B. M. (1999). Cultural primatology comes of age. *Nature* 399:637–38.

de Waal, Frans, B. M. (2005). *Our inner ape*. New York: Riverhead Books.

Douglas, M. (1969). *Purity and danger: An analysis of concepts of pollution and taboo*. London: Routledge & Kegan Paul.

Ehrlich, Paul. R. (2000). *Human natures: genes, cultures, and the human project*. Washington D.C. & Covelo, California: Island Press.

Emerging Technology Series (ETC). (1997). Genetic engineering and biotechnology. Part E. Applications. 4: p. 62;
Gallup, G. G. Jr. (1970). Chimpanzees: self-recognition. *Science* 167:86-87.

Glenn, Linda. MacDonald. (2004). Ethical issues in genetic engineering and transgenics. *ActionBioscience.org* June. (accessed on November 12 2006 at http://www.actionbioscience.org/biotech/glenn.html)

Goodall, Jane. (1990). *Through a window: My thirty years with the chimpanzees of Gombe*. Boston: Houghton Mifflin.

GTC Biotherapeutics GTC Biotherapeutics Reports Third Quarter 2006 Financial Results. http://www.gtc-bio.com/pressreleases/pr110206.html (accessed on December 4, 2006).

Harris, John. (1998). *Cloning and human dignity*. Cambridge Quarterly of Healthcare Ethics 7: 163–67.

Hill, Thomas E., Jr. (1992). *Dignity and practical reason in kant's ethical theory*. Ithaca and London: Cornell University Press .

Hyat, C. W.& W. D. Hopkins. (1994). Self-awareness in bonobos and chimpanzees. In S. T. Parker, R. W. Mitchell, & M. L. Boccia eds. *Self-Awareness in Animals and Humans: Developmental Perspectives*. Cambridge: Cambridge University Press. Pp. 248-253.

Jaenisch, R and B. Mintz. (1974). Simian virus 40 DNA sequences in DNA of healthy adult mice derived from preimplantation blastocysts injected with viral DNA. *Proceedings of National Academic Science* USA 71: 1250-1254.

Johnston, Josephine & Eliot, Christopher. (2003). Chimeras and "human dignity". *The American Journal of Bioethics* 3.3.

Kane, T. (1980). Social behaviour of wild pygmy chimpanzees *(pan paniscus)* of wamba: a preliminary report. *J. ham. Evol.* 9:243-260.

Kant, Immanuel. (1964). *Groundwork of the metaphysics of morals*. H. J. Paton. trans. New York: Harper and Row.

Karpowicz, Phillip, Cohen, Cynthia, B. & Derek van der Kooy. (2005). Developing human-nonhuman chimeras in human stem cell research: ethical issues and boundaries. *Kennedy Institute of Ethics Journal* 15 (2): 107-134.

Kass, Leon F. (2002). Life, liberty, and the defense of dignity: *The Challenge for Bioethic*s. San Francisco: Encounter Books.

Kass, Leon F. (2001). Why we should ban human cloning now: Preventing a brave new world. *The New Republic* 17 May (Accessed on December 15 2006 at http://www.thenewrepublic.com/052101/kass052101_print.html)

Kass, Leon F. (1997). The Wisdom of Repugnance. *New Republic* 2: 17–26.

Khroutski, K.S. 2006. BioCosmology – Science of the universal future." *E-Logos: Electronic Journal for Philosophy*. (Accessed on December 18 2006 at http://nb.vse.cz/kfil/elogos/science/khrou106.pdf)

King, Jonathan., Stabinsky, Doreen. (1998). Biotechnology under globalisation: the corporate expropriation of plant, animal and microbial species. *Race and Class: A Journal for Black and Third World Liberation*
October. http://hornacek.coa.edu/dave/Reading/race.class.html (accessed on 15 November, 2006).

Krieger, L. M. (2002). Scientists put a bit of man into a mouse. *Mercury News* 8 December. Available from: http://www.bayarea.com/mld/mercurynews/4698610.htm.

Kuroda, S. (1984). Interaction over food among pygmy chimpanzees. In R. Sussman, ed. *The pygmy chimpanzee.* New York: Plenum. Pp. 301-324.

Kurzweil, Ray. (1999). *The age of spiritual machines: When computers exceed human intelligence*. New York: Viking.

Lefebvre, L. (1982). Food exchange strategies in an infant chimpanzee. *J. hum. Evol.* 11:195-204.

Lethmate, J. & G. Dücker. (1973). Untersuchungen zum Selbsterkennen im Speigel bei Orang-Utans un einigen anderen. *Zeitschrift für Tierpsychologie* 33:248-269.

Levi-Strauss, Claude. (1978). *Myth and meaning*. London: Routledge and Kegan Paul.

Lorenz, Konrad. (1991). *Here i am—where are you?* New York: Harcourt, Brace, and Jovanovich.

Margawati, Endang. Tri. (2003). Transgenic animals: their benefits to human welfare. *ActionBioscience.org* January. http://www.actionbioscience.org/biotech/margawati.html (accessed on December 3, 2006).

McComb, K., L. Baker, & C. Moss. (2005). African elephants show high levels of interest in the skulls and ivory of their own species. *Biology Letters.* http://www.elephantvoices.org/why_comm/McComb.pdf.

McRae, M. (2000). Central africa's orphaned gorillas: will they survive the wild?" *National Geographic* February: 86–97.

Miles, H. L. W. (1994). Me Chantek: The development of self-awareness in a signing orang-utan. In S. T. Parker, R. W. Mitchell, & M. L. Boccia eds. *Self-Awareness in Animals and Humans: Developmental Perspectives*. Cambridge: Cambridge University Press. Pp. 254-272.

Modell, Stephen M. 2006. The Two Arrows of Efficiency: A Commentary on KonstantinS. Khroutski's BioCosmology – *Science of the Universal Future*. *E-Logos:*

Electronic Journal for Philosophy. Pp. 1-10. (Accessed Decemebr 18 2006 at http://nb.vse.cz/kfil/elogos/science/modell06.pdf)

Newman, W. R. (2004). *Promethean ambitions: alchemy and the quest to perfect nature*. Chicago: University of Chicago Press.

Nishida, T. (1970). Social behavior and relationship among wild chimpanzees of the mahali mountains. *Primates* 11:47-87.

Noor, R. R. 1996. *Genetika Ternak*. Penebar Swadaya. Jakarta.

Ourednik, V., J. Ourednik, J. D. Flax et al. (2001). Segregation of human neural stem cells in the developing primate forebrain. *Science* 293:1820-24.

Polzin, V. J.; Anderson, D. L.; Anderson, G. B.; et al. (1987). Production of sheep-goat chimeras by inner cell mass transplantation. *Journal of Animal Science* 65: 325–30.

Porter, Jean. (1999). Natural and divine law: Reclaiming the tradition for christian ethics. Grand Rapids: William B. Eerdmans.

Pullman, Daryl. (2004). Death, dignity and moral nonsense. *Journal of Palliative Care* 20: 171–78.

Pusey, A. (1983). Mother-offspring relationships in chimpanzees after weaning. *Anim. Behau.* 31:363-377.

Rifkin, Jeremy. (2005). Giving new meaning to 'of mice and men. *Jewish World Review* March 18, 7 Adar II,
5765. http://www.jewishworldreview.com/0305/rifkin_mouse_human.php3 (accessed December 1, 2006).

Roan, S. (1989). *Ozone crisis: The fifteen-year evolution of a sudden global emergency*. New York: Wiley.

Robert, Jason Scott. & Baylis, Francoise. (2003). Crossing species boundaries. *American Journal of Bioethics* 3 (3): 1–13.

Sample, Ian. (2006). Stem cell experts seek rabbit-human embryo. *The Guardian* January 13. http://www.guardian.co.uk/science/story/0,3605,1685534,00.html (accessed on December 3, 2006).

Savage-Rumbaugh, Sue. (1991). Language learning in the bonobo: How and why they learn? In Norman A. Krasnegor ed. *Biological and Behavioral Determinants of Language Development*. Hillsdale, NJ: Lawrence Erlbaum. Pp. 209-33.

Savage-Rumbaugh, Sue., Stuart G. Shanker & Talbot J. Taylor. (1998). *Apes, language and the human mind*. New York: Oxford University Press.

Savulescu, Julian. (2003). Human-Animal Transgenesis and Chimeras Might Be an Expression of Our Humanity. *The American Journal of Bioethics* (summer) 3 (3): 22-25.

Silk, J. (1978). Patterns of food sharing among mother and infant chimpanzees at gombe national park, tanzania. *Folk primatol.* 29:129-141.

Silk, J. (1979). Feeding, foraging, and food sharing behavior of immature chimpanzees. *F&a primatol.* 31:123-142.

Silk, J. (1982). Altruism among female *Macnca radiata:* explanations and analysis of patterns of grooming and coalition formation. *Behaviour* 79:162-188.

Silver, Lee. M. (1997). *Remaking eden: How genetic engineering and cloning will transform the american family*. New York: Avon Books.

Stout, Jeffrey. (1988). *Ethics after babel: The languages of morals and their discontents*. Boston: Beacon Press.

Streiffer, Robert. (2003). The yuck factor: In defense of the moral relevance of species boundaries. *The American Journal of Bioethics* 3 (3):37-38.

Sundberg, M. L. (1996). Toward granting linguistic competence to apes: A review of Savage-Rumbaugh et al.'s *Language comprehension in ape and child*. *journal of the experimental analysis of behavior,* 65, 477-492.

Swartz, K. & S. Evans. (1994). Social and cognitive factors in chimpanzee and gorilla mirror behvavior and self-recognition. In S. T. Parker, R. W. Mitchell, & M. L. Boccia eds. *Self-Awareness in Animals and Humans: Developmental Perspectives*. Cambridge: Cambridge University Press. Pp.189-205.

Van Schaik, Carel. (2006). Why are some animals so smart? *Scientific American* 16 (2):30-37.

Whiten, A., et al. (1999). Cultures in Chimpanzees. *Nature* 399:682–85.

Whitman, Ruth. Do dogs mourn? *Friends of the Animals, Project H.A.L.O.* http://www.friendsoftheanimals.com/articles.htm (accessed on December 5, 2006).