JAHR | Vol. 6/1 | No. 11 | 2015

UDK: 572:179.3-025.26:34:608.1(045)
Review article
Received: 25.02.2015.

Shane Patrick McNamee, The Research Centre for Consumer Law, The University of Bayreuth*

Human-Animal Hybrids and Chimeras: What's in a Name?

ABSTRACT

This paper seeks to analyse public opinion and understanding of human-animal hybrid and chimera research; an area in which there are particularly strong opinions and reactions, but perhaps relatively little understanding or effective communication with the public. The paper will begin with a look at the mythological, historical and science-fiction connotations of these sorts of terms, and where the negative public opinions may have originated. The extent of this sort of research, and what precisely is covered by the various terms (such as xenotransplantation, transgenics, hybrids, and chimeras), will be examined. The case of admixed embryos in the UK will be examined as a case study in how sensationalist reporting on both sides of the debate can lead to regulatory difficulties. Finally, this paper will look at how this might more generally affect public policy and regulation in the UK.

Keywords: hybrids; chimeras; transgenics; xenotransplantation; cybrids; admixed embryos; public policy; medical regulation;

* Contact address: Shane P McNamee, Research Assistant, The Research Centre for Consumer Law, University of Bayreuth, 95440 Bayreuth, Email: ShanePMcNamee@gmail.com, Website: www.TheUndisciplined.com, Twitter: @McNameeShane

Introduction

"Part-man, part-animal" or even "half-man, half-beast"[1] – ratios and exact terminology aside - this is a not a description with which many people feel comfortable. There seems to be, for religious, cultural, ethical, medical or psychological reasons, a widespread repugnance to, and moral condemnation of, the idea of mixing humans and animals. At the same time, we are undeniably surrounded by examples of human-animal research and technology. We eat animals, we drink animals' milk, we have people living happily with porcine heart valves[2] and we have mice living slightly less happily with human Huntington's disease.[3] Why then the continuing taboos surrounding the mixture of human and animal genetic material? There exists much public opposition to, but relatively little widespread understanding of, these controversial scientific developments. It is perhaps the case that misinformation, exaggerations by both sides of the debate and strongly held traditional views have significantly clouded this debate.

In an effort to address where and why we have drawn the line, legally and ethically, regarding research into human-animal hybrids and chimeras, this paper will look at the historical connotations of the terms "hybrid" and "chimera", as well as how human-animal admixtures have been, and are, viewed by society.[4] The next point to address is what sort of research is actually taking place or being proposed and what these terms mean from a scientific perspective. A close look will be taken at the question of human-animal admixed embryos as regulated by the UK Human Fertilisation and Embryology Act 2008, the licences it allows the Human Fertilisation and Embryology Authority (HFEA) to grant, and finally at how fear and moral panics might be driving much of the debate and public policy in this field.

[1] Though humans can relatively uncontroversially be classified as animals, for the purpose of this paper 'animal' shall be taken to mean 'non-human animal'. Similar distinction is made by Section 4A (8) HFE Act 1990 as inserted by HFE Act 2008 Section 4.

[2] R A Manji et al, "Porcine bioprosthetic heart valves: The next generation", (Aug 2012), *Am Heart Journal*, 164(2),177-185. doi: 10.1016/j.ahj.2012.05.011.

[3] The Jackson Laboratory, "Huntington's Disease Mouse Model To Be Distributed By Jackson Laboratory", (2 Apr 1997), *Science Daily*, available at; http://www.sciencedaily.com/releases/1997/04/970402124046.htm

[4] If you're not certain that society has a generally negative reaction to the terms "human hybrid" or "human chimera", try a quick Google image search for either of those terms... Though it must be said that a regular Google text search does provide a more balanced cross-section of opinions.

Hybrids and Chimeras in (Un)Popular Culture

The History and Mythology of Man and Beast

History is filled with references to abominations and monsters which are "part-man and part-beast" (better. half means 50 %).[5] The term "chimera" comes from the monster in Greek mythology with the head of a lion, the body of a goat and a serpent for a tail.[6] Greek mythology particularly refers to numerous such unnatural cross-breeds, either as a result of a curse or, more often than not, the inter-breeding of man (or god) and animal. The Minotaur is one famous such beast, the offspring of the Cretan Bull and the wife of King Minos.[7] The Minotaur is almost invariably portrayed as an abomination and the coupling of the Cretan Bull and King Minos' wife was a punishment for Minos' disobedience. It is interesting to note that the Minotaur, with the head of a bull, is seen as completely beastly, whereas in other cases a centaur, with the upper body of a man and the lower body of a horse, might be seen as more civilised and less inherently evil (such as the mentor Chiron)[8] - this could be tied to perceptions of 'humanity' being tied to certain parts of the body such as the head or the heart.[9] Indeed, the minutiae of historical depictions of hybrids and chimeras and their corresponding levels of "monstrousness" is a topic which could merit, and probably has merited papers of its own.

Such stories very often touch on the idea of human-animal mixtures as a punishment or result of sexual depravity, and normally result in an abhorrent monster. The early justifications for laws against bestiality relied of the idea that such acts were contravening God's will, but also stemmed from fears about creating human-animal abominations.[10] Similar themes are seen in Christian mythology - the devil often

---

[5] S Lundin, "The boundless body: Cultural perspectives on xenotransplantation", (1999) *Ethnos: Journal of Anthropology*, 64(1), 5-31, at 19; "There are stories with deep historical roots about hybrids arising from mixtures of human and inhuman. Monsters - half-human, half-animal - are said to have been born as a result of bestiality; other monsters are blends of human and artificial, as in Frankenstein's monster."

[6] Homer, *Iliad,* 6.179–182; "She was of divine stock, not of men, in the fore part a lion, in the hinder a serpent, and in the midst a goat, breathing forth in terrible wise the might of blazing fire." Taken from A T Murray's English translation of the Iliad, (1924), Harvard University Press, Cambridge, MA, William Heinemann Ltd, London.

[7] Pseudo-Apollodorus, *Bibliotheke,* 3.1.4, English translation by J G Frazer, *Apollodorus*, (1913), Loeb Classical Library.

[8] Theoi.com, *Kheiron*, available at http://www.theoi.com/Georgikos/KentaurosKheiron.html

[9] P Karpowicz, C B Cohen and D J Van der Kooy, "Developing Human-Nonhuman Chimeras in Human Stem Cell Research: Ethical Issues and Boundaries", (June 2005), *Kennedy Institute of Ethics Journal,* Vol 15(2), 107-134, at 108. doi: 10.1353/ken.2005.0015

[10] The Bible makes numerous damning references towards bestiality, "Whoever lies with a Beast shall be put to death", Exodus 22:19, (See also Leviticus 18:23, Leviticus 20:15, Leviticus 20:16 and Deuteronomy 27:21), as does the Mishnah, "These are they that are to be stoned: he that has a connection with a beast, and the woman that suffers connection with a beast", Sanhedrin 7:4. Bestiality first became a written, statutory offence in the British

being depicted with the legs and horns of a goat.[11] However, there are notable examples of such human-animal mixtures being revered, as found in the anthropomorphic deities of ancient Egypt or Hinduism.[12] It would be an interesting study to analyse the attitudes of the public towards human-animal admixtures perhaps in Indian society as compared to British or American.[13]

Sci-Fi and Conspiracy Theories

There are still plenty of examples in popular culture of unease at the idea of mixing humans and animals. The term "human-animal hybrid" evokes images of horrific experiments such as in the film *Splice* where Scientist-Adrien-Brody creates a true human-animal hybrid which grows up to be a violent and dangerous monster, or super-soldier experiments to create super-strong human-ape hybrids, as seen in the video game *Far Cry,*[14] or the theory about real-life experiments supposedly conducted by Joseph Stalin.[15] Fears of cross-species zoonotic diseases can also be seen in films such as *28 Days Later,* where the 'rage-virus' is a result of chimpanzee testing which crosses over to humans, and indeed the entire zombie genre is based heavily on the zoonotic rabies virus.[16] Many cannot help the comparison with *The Island of Doctor Moreau*,[17] in which a mad doctor conducts horrific experiments to create and dissect "beast-men".

Isles with The Buggery Act of 1533, 25 Hen. VIII c. 6 , in England, as anti-sodomy legislation brought in against unnatural sexual acts against the will of God and man, making buggery punishable by hanging.

[11] J Fritscher, *Popular Witchcraft: Straight from the Witch's Mouth*, (2004), Popular Press, at 23; "The pig, goat, ram - all of these creatures are consistently associated with the Devil."

[12] For a comprehensive work on Egyptian gods, see R H Wilkinson, *The Complete Gods and Goddesses of Ancient Egypt*, (2003), Thames & Hudson. For Hindu deities, see S Chandra, *Encyclopaedia of Hindu Gods and Goddesses*, (1998), Sarup & Sons, New Delhi.

[13] Similar to, and building on, stem cell research analyses such as B Lander et al, "Harnessing Stem Cells for Health Needs in India", (Jul 2008), *Cell Stem Cell*, Vol 3(1), 11-15, A Bhan, P A Singer and A S Daar, "Human-animal chimeras for vaccine development: an endangered species or opportunity for the developing world?", (May 2010), *BMC International Health and Human Rights,* Vol 10(8), doi:10.1186/1472-698X-10-8, and R M Isasi et al, "Legal and Ethical Approaches to Stem Cell and Cloning Research: A Comparative Analysis of Policies in Latin America, Asia, and Africa", (Dec 2004), *The Journal of Law, Medicine & Ethics,* Vol 32(4), 626-640.

[14] Although it is never made clear whether the 'Trigens' in Far Cry are in fact hybrids or simply another form of 'super-soldier' genetic experiment on both humans and apes, see http://farcry.wikia.com/wiki/Trigens (last retrieved 3 Mar 2014)

[15] E M Johnson, "Scientific Ethics and Stalin's Ape-Man Superwarriors", (10 Nov 2011), *Scientific American: Blogs*, available at http://blogs.scientificamerican.com/primate-diaries/2011/11/10/stalins-ape-man-superwarriors/ referencing K Rossiianov, "Beyond Species: Il'ya Ivanov and His Experiments on Cross-Breeding Humans with Anthropoid Apes", (June 2002), *Science in Context* , Vol 15(2), 277-316. doi: 10.1017/S0269889702000455

[16] See E Inglss-Arkell, "The Virus that Inspired the Whole Zombie Genre", (19 Jun 2012), *i09*, available at http://io9.com/5919645/the-virus-that-inspired-the-whole-zombie-genre , and K Than, ""Zombie Virus" Possible via Rabies-Flu Hybrid?", (27 Oct 2010), *National Geographic News*, available at http://news.nationalgeographic.com/news/2010/10/1001027-rabies-influenza-zombie-virus-science/

[17] H G Wells, *The Island of Doctor Moreau*, (1869), Stone & Kimball 1st ed, New York.

Of course it wouldn't be a controversial scientific field without mentions of secret government labs, such as those in which conspiracy theorist Alex Jones suggests the UK has been "secretively" creating human-animal hybrids.[18] He voices his concerns that governments and private labs are creating "bestial hybrids" and "Franken-breeds" with little regard for the risks to human health,[19] and "[c]reations like spider-goats are raised in contradiction to nature's laws" to produce spider-silk for "the military-prison-industrial complex, further feeding the total domination of mankind."[20] While some of the concerns raised are genuine issues - such as disease, unknown side-effects and excessive financial influence over science - Jones shows himself to be ignorant of many of the basic facts about genetics and prone to exaggerations.[21] Mike Adams draws a confused connection between UK admixed embryo research and *Planet of the Apes*,[22] seemingly misunderstanding what a scientific chimera is, or the fictional science as portrayed in the film. He believes the true aim of scientists is to;

> …raise a secret lab full of half-human (may be better partially human) apes imprisoned in cages, then HARVEST their cells and sell them off to pharmaceutical companies which turn around and offer them to patients at a hundred thousand dollars per treatment.[23]

Medical Monsters

Xenotransplantation and Bio-Pharming

So what *actually* happens in the labs and operating theatres, how far has the mixing of human and animal come? One of the most obvious and relatively uncontroversial areas is that of xenotransplantation - the transplantation of living cells, tissues or organs from one species to another.[24] These procedures have been going on for

[18] See Alex Jones, "Genetic Armageddon: Humanity's Greatest Threat", *YouTube*, available at; http://youtu.be/kCFP_Unf6zA at 8:20 - referencing the even-handed bastion of investigative journalism that is *The Daily Mail*. These secretive labs are a reference to the licensed creation of human-animal admixed embryos.

[19] Aaron Dykes and Alex Jones, "Genetic Genocide: Humanity's Greatest Threat", (27 July 2011), *Infowars.com*, available at; http://www.infowars.com/?p=58728

[20] *Ibid*.

[21] *Supra* note 18, at 7:00, misunderstanding exactly how chimeras or transgenic animals work, seeming to think a predominantly human clone is gestated in a cow-womb.

[22] M Adams, "A real Planet of the Apes? UK scientists secretly grew human-animal hybrids in laboratory experiments", (23 Jul 2011), *NaturalNews.com*, available at; http://www.naturalnews.com/033100_human-animal_hybrids_Planet_of_the_Apes.html#ixzz2QWkvDHWn

[23] *Ibid*.

[24] See definition by the WHO at http://www.who.int/transplantation/xeno/en/

decades now and continue with some degree of success,[25][26] and patients have "expressed a positive attitude" towards the treatments.[27] Nonetheless, there are still conflicting opinions on xenotransplantation, as "some of the recipients felt ambivalent about incorporating animal cells into their bodies, in view of the infectious risks, but also for existential reasons."[28] Regarding existential fears that transplants might significantly alter personality one doctor explained that "we certainly don't transplant souls in this hospital".[29]

In 1995, AIDS patient and activist and Jeff Getty accepted marrow transplants from a baboon,[30] stating; "Society should be bold enough to experiment, to venture xenotransplantation. This is a war!"[31] Others have reacted less positively, Doreen Hackney's opinion in 1996 to a procedure that was stopped by the Nuffield Council on Bioethics was; "No, I don't want a pig's kidney. I'd rather die than live half-human and half-animal."[32] This helps highlight the strong emotional opposition many hold regarding integration of animal biological material into human bodies, but also how a significant proportion of patients feel that having animal parts in them will make them somehow 'less human'. Nonetheless, many patients "preferred animal tissue to artificial alternatives",[33] which indicates that although many policy and ethical arguments against xenotransplantation are absolutist, right-and-wrong moral ones, patients seem willing to compromise their ideals given the circumstances.[34] People can also hold rather symbolic and irrational views on bodily tissue, such as one diabetic patient who said; "The cells felt okay. . . . But a pig's heart! The heart is the seat of the personality and with a pig that would make it

---

25 H Y Vanderpool, "Xenotransplantation: progress and promise", (13 Nov1999), *BMJ*, 319(7220), 1311.

26 BBC News Sci/Tech, "The history of xenotransplantation", (19 Aug 1999), *BBC News*, available at http://news.bbc.co.uk/1/hi/sci/tech/425120.stm

27 C G Groth et al, "Clinical aspects and perspectives in islet xenotransplantation", *J Hepatobiliary Pancreat Surg*, (2000), 7(4), 364-369, at 367.

28 *Ibid*.

29 G Haddow, "Gentlemen, we have the technology we can rebuild him....", (19 March 2013), *Mason Institute Lunch Talk*, slides available at http://masoninstitute.org/wp-content/uploads/2013/04/MIlunch6milliondollar-manv3forPM.ppt , citing S Lundin, "Creating identity with biotechnology: The xenotransplanted body as the norm", (2002), *Public Understanding of Science*, 11(4), 333-345, at 337.

30 Baboons have a natural resistance to AIDS. Source: M G Michaels et al, "Baboon bone-marrow xenotransplant in a patient with advanced HIV disease: case report and 8-year follow-up." *Transplantation*, (15 Dec 2004), 78(11), 1582-1589.

31 S Lundin and H Widner "Attitudes to Xenotransplantation: Interviews With Patients Suffering From Parkinson's Disease Focusing on the Conception of Risk", (Aug 2002) *Transplant Proc*, 32(5), 1175-1176.

32 Lundin, *supra* note 5, citing Panorama, "Animal Transplants", (Jun 1996), *BBC 1*. See also *Animal-to-Human Transplants: The Ethics of Xenotransplantation*, (1996), Nuffield Council on Bioethics, London.

33 *Supra* note 31, at 1175.

34 This will be noticeable later in discussion of attitudes towards cybrids.

repulsive",[35] while others might have more measured worries about the ethical implications of transplants;

> The personality is in the brain. If you add a very small quantity of cells from a pig to an existing brain, that's ok. But if we were talking about replacing half of the cerebrum, then we would be replacing a large share of the individual's personality.[36]

To further the confusion, certain parties have used pseudo-scientific arguments to oppose such research, such as how the immunological concept of 'cell memory' has been misinterpreted by some to suggest that cells might remember a donor's thoughts and feelings.[37]

Many everyday products are derived from animals or animal tissue, and more and more compounds are being produced though "bio-pharming" for human use. A good example of this is that bovine collagen is widely used as dermal filler for treatment of wrinkles and skin aging.[38] Though there are at times some BSE worries,[39] there is no major opposition to this integration of animal material in the human body - the recipients of these treatments are not seen to be 'part-cow'. In the UK, the short-lived, non-statutory United Kingdom Xenotransplantation Interim Regulatory Authority (UKXIRA) was founded in 1997 and could technically approve applications for xenotransplantation research on humans. However, it published its last annual report in May 2006, stating "there is currently very little going on in terms of xenotransplantation – specifically no large animal organ transplants have been carried out",[40] and was disbanded on 12 December 2006. Some were concerned about a lack of remit to conduct an ethical assessment of animal-human transplantation.[41, 42]

---

[35] *Supra* note 33. For further examples of (irrationally) associating the heart with personality changes see the autobiographical book *Change of Heart*, by Claire Sylvia (1997) which tells of how she received a heart and lung transplant and began to feel the presence of someone else inside her.

[36] *Supra* note 33.

[37] Lundin, *supra* note 5, at 18, citing D Chopra, (1994), *Tidlös till kropp och själ,* Norstedt, Stockholm.

[38] PharmaXChange, "The Ageing Skin - Part 4e - Dermal Fillers", (9 Mar 2011), *pharmaxchange.info*, available at http://pharmaxchange.info/press/2011/03/the-ageing-skin-part-4e-dermal-fillers/

[39] Matrix BioScience, "BSE Risk-Management", *MatrixBioScience.com,* available at http://www.matrixbioscience.com/en/products/collagens-overviewhtml/bse-risk-management.html

[40] UKXIRA, "Summary Notes of Thirty-Second Meeting", (9 May 2006) .

[41] S McLean and L Williamson, *Xenotransplantation: Law and Ethics*, (2005), Ashgate.

[42] J Wright, book review of; S McLean and L Williamson, *Xenotransplantation: Law and Ethics*; (Dec 2006), *SCRIPTed*, Vol 3(4), 491-492, doi: 10.2966/scrip.030406.491, available at http://www.law.ed.ac.uk/ahrc/scripted/vol3-4/jw_review.asp

Transgenics and True Hybrids

First of all it is important to define the terms 'transgenic' and 'true' hybrids. 'Transgenic' simply means that a gene from one species has been isolated and transferred (normally through recombinant DNA techniques) to the genetic make-up of another species. Animal-animal transgenics have proven useful and for the most part non-controversial, such as the gene for the expression of Green Fluorescent Protein (GFP) which has been isolated from jellyfish and inserted into mice, goldfish and a number of other animals for scientific and even commercial reasons.[43] Transgenic mice are frequently used in research, even those with human genetic material.[44] The purpose of inserting human genes into mice is normally to express a human disease and allow new treatments be tested on these transgenic animals rather than human test subjects. A 'human transgenic embryo' would be a human embryo into which certain non-human genes were inserted. In the UK this is only permissible with a HFEA licence and would have to be destroyed after 14 days.[45]

As mentioned in the introduction, transgenic mice with human Huntington's disease have been particularly helpful in research into disease treatment.[46] Transgenic animals with human genes remain animals and could only be seen as 'human' in the tiny percentage of their overall genome which has been changed. Considering humans share a great deal of genetic similarity with all living things,[47] why would the addition of a few genes for certain specific functions be seen as an unprecedented leap across the ultimate boundary between human and animal?[48] In bio-pharming, as discussed above, 'transgenic' bacteria are created (using recombinant DNA technology) by inserting the gene for human insulin production into e-coli bacteria

[43] K Ravilious, "Chemistry Nobel Prize Awarded for Glowing Protein Work", (8 Oct 2008), *National Geographic News*, available at http://news.nationalgeographic.com/news/2008/10/081008-nobel-chemistry.html see also US company Yorktown Technologies marketing green fluorescent zebrafish at http://www.glofish.com/

[44] L J Martin, "Transgenic mice with human mutant genes causing Parkinson's disease and amyotrophic lateral sclerosis provide common insight into mechanisms of motor neuron selective vulnerability to degeneration", (2007), *Rev Neurosci*, 18(2), 115-136.

[45] Human Fertilisation and Embryology Act 1990, Section 4A(3), as amended by Human Fertilisation and Embryology Act 2008, Section 4(2).

[46] B R Underwood et al, "Huntington disease patients and transgenic mice have similar pro-catabolic serum metabolite profiles", (Apr 2006), *Brain*, Vol 129(4), 877-886.

[47] J Marks, "98% Chimpanzee and 35% Daffodil: The Human Genome in Evolutionary and Cultural Context", In *Genetic Nature/Culture: Anthropology and Science beyond the Two-Culture Divide*, (2003), eds A Goodman, D Heath and M S Lindee, University of California Press, Berkeley, CA, 132-152.

[48] Mr. Edward Leigh (Gainsborough)(Con), *House of Commons Parliamentary Debates*, 19 May 2008, Column 23, available at; http://www.publications.parliament.uk/pa/cm200708/cmhansrd/cm080519/debtext/80519-0004.htm

to mass-produce synthetic human insulin.[49] This is widely accepted and not seen as controversial, especially given that the previous methods was to use actual porcine and bovine insulin - another example of using animal biological material in humans which itself proved relatively uncontroversial despite some issues with allergic reactions.[50]

The most controversial of all human-animal admixtures is probably the 'true hybrid', perhaps most scary because they are the closest to natural reproduction and echo our ancient fears about the inter-breeding of species and creation of abominations. A true hybrid is an organism created from the successful fertilisation of an ovum/oocyte with the sperm of another animal. The most common example of this is the mule.[51] Hybrids normally result with an uneven number of chromosomes and as such are sterile.[52] Many worry that research into true hybrids might lead to the creation of a 'humanzee', by combining human and chimpanzee gametes.[53] However it is likely that such worries are unfounded, for both practical and legal reasons; successfully creating a mammal hybrid is difficult - there have been only a handful of successes in the field of conservation -[54] and a human-animal hybrid would be very difficult to bring to full term even if scientists for some reason wanted to. Robert Streiffer said that a humanzee endowed with speech and enhanced cognitive capacity raises interesting questions which we take for granted; "There's a knee-jerk reaction that enhancing the moral status of an animal is bad ... But if you did it, and you gave it the protections it deserves, how could the animal complain?"[55] Though others, such as Michael J Sandel, worry that such protections are unlikely.[56]

These worries are somewhat reminiscent of the 1952 novel by Jean Bruller, under his pseudonym Vercors, *Les animaux dénaturés (*also called *You Shall Know Them* in

[49] L Skene and J Savulescu, "The Ethics of 'Human Admixed Embryos': Concerns and Responses", (19 May 2008), *University of Oxford: Practical Ethics Blog*, available at; http://blog.practicalethics.ox.ac.uk/2008/05/the-ethics-of-human-admixed-embryos-concerns-and-responses/

[50] A H Skelly and A R Van Son, "Insulin allergy in clinical practice", (Apr 1987), *Nurse Pract*, Vol 12(4), 14-18.

[51] M Rodriguez, "Chimeras, Mosaics, and Other Fun Stuff", (20 June 2007), *The Tech,* available at; http://genetics.thetech.org/ask/ask225

[52] N Johnson, "Hybrid incompatibility and speciation", (2008), *Nature Education* , 1(1), available at; http://www.nature.com/scitable/topicpage/hybrid-incompatibility-and-speciation-820

[53] Incidentally, any 'humanzee' would probably be infertile with 47 chromosomes, resulting from a human parent with 48 and a chimp parent with 46.

[54] F W Allendorf et al, "The problems with hybrids: setting conservation guidelines", (November 2001), *Trends in Ecology & Evolution,* Vol 16(11), 613-622. doi:10.1016/S0169-5347(01)02290-X

[55] R Weiss, "Of Mice, Men and In-Between: Scientists Debate Blending Of Human, Animal Forms", (20 Nov 2004), *The Washington Post*, available at; http://www.washingtonpost.com/wp-dyn/articles/A63731-2004Nov19.html

[56] *Ibid*.

English).[57] In this novel, the moral question of the genetic similarity of humans and higher primates is cleverly addressed. Anthropologists in New Guinea find a population of ape-like creatures, which they name Tropis. However, all is not well for the Tropis and soon a businessman named Vancruysen decides to use them as slave labourers without rights or pay. The anthropologists decide they must come up with a definitive answer to the question of whether or not the Tropis are human. They had, up to this point, avoided doing this on the grounds that fixing an arbitrary limit between human and non-human is ethically difficult to justify, as discussed above, and akin to the sorites paradox.[58] They initially attempt to use the standard species defining criterion of interfertility, but it appears that Tropi females can be impregnated by sperm from both man and ape. To force the authorities to reach a decision, thus giving legal protection of the Tropis whether as animals or citizens, one of the scientists deliberately kills the baby born from one Tropi female impregnated by his own sperm. The trial will then determine whether he committed murder, (making the Tropis human) or simply killed an animal. In light of the very slight genetic dissimilarity of humans to many higher order primates, and the growing understanding of the capacity for "consciousness", self-awareness and higher order intelligence in other animals, the ethical questions such as those raised regarding the Tropis could indeed be tricky to address; though it is once again important to note that this still very much lies in the realms of science fiction and not current genetic research.

Further, the legal frameworks regulating creation of any such true hybrids in the UK would require they be destroyed before fourteen days or the emergence of the primitive streak,[59] whichever is earliest. Even if this were not the case, the HFEA must issue a license before any such experiment can be undertaken, which it is unlikely to do if the project has dangerous or unethical goals in mind. As such, there is little current interest in creating a human-animal 'true hybrid', though it seems it is this concept of a truly genetic 'half-man, half-beast' which most upsets people.[60] By refraining from completely prohibiting these true hybrids, the UK system merely allows for the possibility that in the future we may find an ethical and practical use for research in this direction. The various categories of hybrids and

[57] Vercors, *You Shall Know Them*, (1953), translated by Rita Barisse, Boston: Little, Brown.

[58] D Hyde, "Sorites Paradox", (Spring 2014 Edition), *The Stanford Encyclopedia of Philosophy,* Edward N. Zalta (ed.), forthcoming, available at http://plato.stanford.edu/archives/spr2014/entries/sorites-paradox/

[59] This is the earliest point at which an embryo can be seen to have developed the basic structure for its future growth. This 14-day/primitive streak limit applies to all human-animal admixed embryos.

[60] D Derbyshire, "Beware 'Planet of the Apes' experiments that could create sci-fi nightmare", (22 Jul 2011), *Daily Mail Online*, available at; http://www.dailymail.co.uk/sciencetech/article-2017475/Beware-Planet-Apes-experiments-create-sci-fi-nightmare.html

chimeras are set out in the HFEA 2008 as (a) cybrids, (b) 'true hybrids', (c) transgenic human embryos, (d) chimeras and (e) any other unforeseen admixture.[61]

Chimeras

Chimeras are one of the least understood categories of human-animal admixtures, as many commentators simply do not grasp the scientific distinction between a chimera and hybrid.[62] The key point about chimeras is that they contain cells, tissue, even organs, from two genetically distinct sources, within one body. At any embryonic level a chimera embryo is a developing embryo to which another organism's cells have been added and integrated. These can occur naturally in humans, often when 'twin' embryos fuse at a very early stage; the embryo can continue to successfully develop using cells from both genetic backgrounds, resulting in a person with two genetically distinct sets of cells making up different parts of their body.[63] Once genetically foreign tissue has been accepted into the organism it could be called a chimera, extending the category to early embryonic chimeras, foetal chimeras and even xenotransplantation recipients.[64] As with transgenic animals, animal chimeras with human cells can be of great help in

[61] Human Fertilisation and Embryology Act 1990, Section 4A(6), as amended by Human Fertilisation and Embryology Act 2008, Section 4(2), reads:

"(6) For the purposes of this Act a human admixed embryo is—

(a) an embryo created by replacing the nucleus of an animal egg or of an animal cell, or two animal pronuclei, with—
  (i) two human pronuclei,
  (ii) one nucleus of a human gamete or of any other human cell, or
  (iii) one human gamete or other human cell,

(b) any other embryo created by using—
  (i) human gametes and animal gametes, or
  (ii) one human pronucleus and one animal pronucleus,

(c) a human embryo that has been altered by the introduction of any sequence of nuclear or mitochondrial DNA of an animal into one or more cells of the embryo,

(d) a human embryo that has been altered by the introduction of one or more animal cells, or

(e) any embryo not falling within paragraphs (a) to (d) which contains both nuclear or mitochondrial DNA of a human and nuclear or mitochondrial DNA of an animal ("animal DNA") but in which the animal DNA is not predominant."

[62] For an example, see the title of this broadcast, "DNA Tests Shed Light on 'Hybrid Humans'", which is in fact discussing human chimeras and not hybrids in a scientific meaning of the word; http://www.npr.org/templates/story/story.php?storyId=1392149

[63] This can lead to medical and DNA-test confusion, such as with Lydia Fairchild, who had given birth to her children but initial DNA-tests indicated that she was not their biological mother. It was only discovered later that she was a chimera, carrying two different sets of DNA, and her ova had developed from a different set than the skin taken for the DNA test. A documentary was made about her story entitled, "The Twin Inside Me: Extraordinary People" by TV5. For the article which brought the phenomenon to her lawyer's attention, see also; Y Neng et al, "Disputed Maternity Leading to Identification of Tetragametic Chimerism", (16 May 2002), *New England Journal of Medicine*, 346(20): 1545–1552. doi:10.1056/NEJMoa013452

[64] *Supra* note 9.

developing and testing treatments for human conditions without the need for human test subjects.[65]

Henry Greely, a law professor and ethicist at Stanford University, opines that "Chimeras are not as strange and alien as at first blush they seem."[66] A number of beneficial experiments have been carried out with this technology. The controversy with chimeras is that the human cells inserted into an animal embryo do remain genetically human, even if they adhere to the structure of that animal's anatomy. Fears remain that if enough significant tissue, particularly brain tissue, in the animal was in fact human "there is a nontrivial risk of conferring some significant aspects of humanity" on the animal.[67] For this reason it is safer to insert cells aimed towards a specific purpose (eg. to grow a genetically human kidney) rather than simply inserting a mass of stem cells into the animal embryo, to see where they might end up - though some might be curious to try this.[68] Thus, it is suggested that only differentiated (rather than pluripotent stem cells), disassociated cells[69] be used.

In one experiment with non-disassociated quail cells inserted into a chicken embryo,[70] parts of the resulting brain were completely quail and seemed to result in quail behaviour in the resulting animal, suggesting that cognitive functions can in fact be transferred in this way. As such there is the worry that using non-disassociated human cells in an ape embryo could imbue the ape with human cognitive capacities, leading to a serious moral dilemma. As put by Christopher Shaw of the Institute of Psychiatry, King's College London; "If you come home and your parrot says 'Who's a pretty boy?' that's one thing. But if your monkey says it that's something else".[71] Thus, many of the worries about human-animal chimeras are based on fears that it might have fully human reproductive and neural cells, resulting in ethical dilemmas as to how to treat a partially-human animal or the offspring of any animal. If two such human-mouse-chimeras were to mate, a human embryo might form, trapped in an animal, though Ann McLaren asks "What would be so dreadful?", given that

65 M W Lensch et al, "Teratoma Formation Assays with Human Embryonic Stem Cells: A Rationale for One Type of Human-Animal Chimera", (13 Sep 2007), *Cell Stem Cell*, Vol 1(3), 253-258.

66 *Supra* note 55.

67 *Ibid*.

68 *Supra* 9, at 123-124.

69 *Ibid*, at 129.

70 E Balaban, M A Teillet, N Le Douarin, "Application of the quail-chick chimera system to the study of brain development and behavior", (9 Sep 1988), *Science*, Vol 241(4871), 1339-1342. doi: 10.1126/science.3413496

71 B Hirschler, "New rules urged on hybrid animal-human experiments", (21 Jul 2011), *Reuters*, available at http://www.reuters.com/article/2011/07/21/us-science-animal-human-idUSTRE76K7Q220110721

no human embryo could develop successfully in a mouse womb, it would simply die at the earliest stages of development.[72]

Cybrids

Human-animal 'cybrids' (short for 'cytoplasmic hybrids') are formed by transferring human nuclear DNA into cytoplasm from the oocyte of an animal;[73] these cells can then be electrically or chemically triggered to begin division and blastocyst formation.[74] The practical result of this is a mass of cells with a human nuclei but some animal mitochondrial DNA remaining in the cytoplasm. These cells are said to be 99.9% human,[75] and as such are considered by many as (confusingly) a less controversial way of sourcing blastocysts for research purposes. However, the reason such cells have come to public attention is the controversy which surrounded their creation in the UK after licensing by the HFEA and the subsequent debates and legislative clarifications brought in by the HFE Act 2008. This combination of human nuclear DNA and animal mitochondria might well make a difference to the resulting cells, but not enough is known about mitochondrial disorders to predict what the effects might be, indeed Dr Justin St John from Birmingham University believes that the creation cybrids might give scientists the "opportunity to elucidate some of the causes of mitochondrial DNA disease" and that "not to allow this work to go ahead would considerably disadvantage experimental work in these fields".[76]

One of the primary reasons for advocating human-animal cybrid embryos is that human oocyte donation is a potentially dangerous procedure, which can trigger ovarian hyper stimulation syndrome in up to one third of treated women, sometimes even requiring hospitalisation.[77] The safety issues and ethical problems regarding pressuring women to donate oocytes if financially incentivised could be solved by using animal oocytes instead. A huge number are needed for research as the success

---

[72] *Supra* note 55.

[73] HFEA, "Hybrids and Chimeras: A consultation on the ethical and social implications of creating human/animal embryos in research", (Apr 2007), *Human Fertilisation and Embryology Authority*, para 2.8.

[74] P A De Sousa et al, "Somatic cell nuclear transfer in the pig: control of pronuclear formation and integration with improved methods for activation and maintenance of pregnancy", (2002), *Biol Reprod*, Vol 66, 642-650.

[75] The Wellcome Trust and Medical Research Council, "Evidence from the Medical Research Council and the Wellcome Trust", (22 Jan 2007), House of Commons Science and Technology Committee, Government proposals for the regulation of hybrid and chimera embryos, para 9(a), available at; http://www.wellcome.ac.uk/About-us/Policy/Spotlight-issues/Human-Fertilisation-and-Embryology-Act/Consultation-responses/index.htm

[76] House of Commons Science and Technology Committee (SCT), "Fifth report of session 2006–07. Government proposals for the regulation of hybrid and chimera embryos", (2007), Stationery Office, London, (HC 272-I), para 57, available at http://www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/272/272i.pdf

[77] Practice Committee of the American Society for Reproductive Medicine, "Ovarian hyperstimulation syndrome", (Nov 2008), *Fertil Steril*, 90(5 Suppl), 188-193. doi: 10.1016/j.fertnstert.2008.08.034

rate for derivation of ESCs from oocytes in primates is only 0.7%.[78] As there has been a great deal of public discussion about cybrids, which covers many of the moral questions and misunderstandings common to all human hybrids and chimeras, the case of cybrids will be discussed in greater detail below.

UK Admixed Embryos: A Case Study in Confusion[79]

Camporesi and Boniolo say of the UK admixed embryo debate, specifically of cybrid embryos, that the terms "chimera" and "hybrid" are improper and their use can bias the debate and create moral prejudices.[80] While other admixtures governed by the HFE Act 2008 could in fact be true hybrids or chimeras, their analysis, focussing primarily on cybrids, hammers home the public fear and repugnance that these terms tend to illicit. Polls conducted at the time of the HFE Bill debates showed a wide variance in levels of opposition to human-animal hybrid embryos, anything from 45%-90%.[81] These polls and responses to the public consultation were unclear, inconsistent, but indicative there is at least significant opposition. Answers varied depending on how much information was given with the question, particularly if it was specifically hinted that the research could result in improved treatments;

> [the] HFEA found that these figures change dramatically when specific diseases (Parkinson disease and motor neuron disease) were named. In this case, only 25% were opposed while 61% supported the research,[82]

This raises the question of how absolute or inalienable moral arguments against human-animal admixtures are, if they can be compromised for the prospect of curing diseases, the negative feelings against which are even stronger than the negative feelings against admixtures. If this research is wrong because it "crosses the

[78] J A Byrne et al, "Producing primate embryonic stem cells by somatic cell nuclear transfer", (22 Nov 2007), *Nature,* Vol 450(7169), 497-502.

[79] For a comprehensive overview of the public responses to this debate see Human Fertilisation and Embryology Authority (HFEA), "Hybrids and Chimeras: A report on the findings of the consultation", (2007), HFEA, London, available at http://www.hfea.gov.uk/docs/Hybrids_Report.pdf

[80] S Camporesi, G Boniolo, "Fearing a non-existing Minotaur? The ethical challenges of research on cytoplasmic hybrid embryos", (2008), *J Med Ethics*, Vol 34, 821–825. doi:10.1136/jme.2008.024877

[81] D A Jones, "What does the British public think about human–animal hybrid embryos?" (2009), *J Med Ethics*, Vol 35,168-170 doi:10.1136/jme.2008.026336

[82] *Ibid*, citing Human Fertilisation and Embryology Authority (HFEA), "Hybrids and Chimeras: A report on the findings of the consultation ", (2007), HFEA, London, Appendix F, Para 13.

ultimate boundary between animals and humans",[83] does it become less wrong because it could help fight a terrible disease (about which the public has heard)?[84]

Not to be facetious, but it is worth imagining how opinions might differ if such entities were named something like "pre-implantation genetically diverse blastocysts" instead of "human-animal hybrid embryos". The public do not always fully understand the science behind the hype, and understandably react badly to words like "embryo", "hybrid" or "chimera", which have been used to create interest and stir up fear by some parties in the media and opposition to such research. On the other hand, in fostering public education and debate on these issues it is important not to have the public misinformed by government attempts to provide "full and accurate information" which is not, in fact, neutral.[85] Governments and oversight body's often present material favouring their own position, as such, people do not always trust government educational and research initiatives.[86] Even the Parliamentary Science and Technology Committee (STC) report, which was otherwise much in favour of the research, acknowledged the existence of "scientific debate about the potential usefulness of cytoplasmic hybrid embryos in research",[87] however also suspected that "the scientific community as a whole is supportive of the work being licensable, even where there may be doubts about its likely success."[88, 89]

It was evident to the STC that the debate was clouded by conflicting survey statistics, differing interpretation of key terms and public confusion;

> We have seen no conclusive evidence to indicate the true state of public opinion on the creation of animal-human chimera and hybrid embryos for research purposes … We find it unhelpful that witnesses on both sides of the argument have claimed to represent the public view, where supporting evidence for this is lacking.[90]

---

83 *Supra* note 44.

84 The imbalance in funding in favour of exciting sounding new treatments and battling well-known diseases is considered by many to be a serious problem in both clinical medicine and research. See J L Leroy, "Current Priorities in Health Research Funding and Lack of Impact on the Number of Child Deaths per Year", (Feb 2007), *Am J Public Health*, Vol 97(2), 219–223. doi: 10.2105/AJPH.2005.083287 and A Barton, "How high-profile causes like Movember push less 'sexy' ones aside", (11 Nov 2012), *The Globe and Mail*, available at http://www.theglobeandmail.com/life/how-high-profile-causes-like-movember-push-less-sexy-ones-aside/article5161556/

85 *Supra* note 81, at 169.

86 *Ibid*.

87 *Supra* note 76.

88 *Ibid*, para 58.

89 *Supra* note 85.

90 *Supra* note 76, para 113.

Sadly, it seems that incorrect information from the media has led to "the formation of a moral prejudice based on a visceral reaction, by associating to cybrids images of monsters such as the Minotaur or Homer's fire breathing chimera."[91] Recently retired Cardinal Keith O'Brien denounced what he called experiments of "Frankenstein proportion", calling the HFE Bill a "monstrous attack on human rights, human dignity and human life",[92] though his own "credibility and moral authority" to comment on issues of human rights and dignity could be taken into question.[93]

This debate raged around the time of the first tentative successes with induced pluripotent stem cells (iPSCs) and many argued that stem cell research did not need to continue down the human embryonic stem cell (hESC) path, thus the cybrid embryos were not necessary.[94] This point was also raised in the House of Commons debates.[95] However, even those involved in iPSC research[96] have argued that it would be dangerous to invest all hopes in a single approach,[97] as well as clarifying that most of the successes of iPSCs and other forms of stem cell research would have been almost certainly impossible to reach without allowing hESC research in the first place. The fear surrounding the 'true hybrids' clause in the Bill was even more pronounced, and this was demonstrated clearly in that when the House of Commons, on 19 May 2008, voted on the Bill, it voted separately for legalisation of "human admixed" embryos by 336 to 176, and of "true hybrids" by only 286 to 223.[98]

Fear-Based Policy

In light of the significant biases against ideas of human-animal admixtures and the levels of confusion regarding what is actually being discussed, should public opinion be weighted all that heavily when deciding public policy, or is the fact that the

91 *Supra* note 80, at 823.

92 BBC, "Peer and Church clash on embryos", (4 Mar 2008), *BBC News*, available at http://news.bbc.co.uk/1/hi/uk_politics/7310918.stm

93 "Cardinal Keith O'Brien Sex Scandal 'A Serious Blow' To Catholic Church In Scotland", (Mar 2013), *Huffingtonpost.co.uk*, available at http://www.huffingtonpost.co.uk/2013/03/04/cardinal-keith-obrien-sex-scandal-catholic-church-scotland_n_2807423.html

94 FRAME, "FRAME Chairman warns UK should invest more in adult stem cell research", (4 Jun 2010), *Fund for the Replacement of Animals in Medical Experiments: Press Release*, available at http://www.frame.org.uk/dynamic_files/frame_press_release_human_stem_cells.pdf

95 *Supra* note 48.

96 K Takahashi , S Yamanaka, "Induction of pluripotent stem cells from mouse embryonic and adult fibroblast cultures by defined factors", (2006), *Cell,* Vol 126, 663-676.

97 H Gottweis, S Minger, "iPS cells and the politics of promise", (2008), *Nat Biotechnol*, Vol 26, 271-272.

98 *Supra* note 81, at 168.

public supports or opposes something "not enough, on its own, to settle the ethical or political question"?[99] Duncan and Parmelee suggested that while useful in deciding policy, "public opinion cannot be the final arbiter of what is ethically correct".[100] Public opinion has no monopoly of what is ethical, in the past public opinion has opposed slavery abolition, blood transfusions, inter-racial marriage and homosexuality; [101] "it is not clear why ethicists should care about the fact that 90% of people disapprove of x."[102] The utilitarian could point out that public opinion is fickle, and that taking it into account hampers scientific policy.[103] Though Irving Weissman warns that such procedures should be carefully reviewed by a regulatory body; "You must assure yourself and the public that it's ethical. It's not for scientists alone to decide."[104] Though democratic legislative and policy processes are good for preventing radical abuses of power, they create their own sets of problems regarding legislative populism and reactionary law-making.[105]

Opposition based on mere moral repugnance is too visceral and instinctive a reaction on which to build an entire argument; although it could be a decent starting point, it then needs to be supported by rational arguments.[106] Some feel that "[r]epugnance may be the only voice left that speaks up to defend the central core of humanity",[107] while others would counter this by pointing out that "moral outrage at rape or murder is justified not by emotion alone, but for tangible reasons for being outraged".[108] Camporesi and Boniolo dissect the various arguments against human chimeras, asking what right do 'slippery slope arguments' (SSAs) have to pre-emptively stop future researchers should they ever want to make 'true' hybrids or chimeras - only when the HFEA are faced with such a licence application

99 *Ibid*.

100 O D Duncan, L F Parmelee, "Trends in public approval of euthanasia and suicide in the US, 1947–2003", (2006), *J Med Ethics*, Vol 32, 266-272,

101 *Supra* note 9, at 112.

102 E Garrard and S Wilkinson, "Mind the gap: the use of empirical evidence in bioethics", in M Hayry, T Takala and P Herissone-Kelly, eds, *Bioethics and social reality*, (2005), Rodopi, Amsterdam, 73-87.

103 P Hobson-West, "The role of 'public opinion' in the UK animal research debate", (2010), *J Med Ethics*, Vol 36, 46-49. doi:10.1136/jme.2009.030817

104 N Wade, "Stem Cell Mixing May Form a Human-Mouse Hybrid", (27 Nov 2002) *The New York Times*, available at; http://www.nytimes.com/2002/11/27/science/27CELL.html (last retrieved 3 Mar 2014).

105 See K P. Miller, "Constraining Populism: The Real Challenge of Initiative Reform", Symposium,(2001) *Santa Clara L. Rev*. Vol 41, available at http://digitalcommons.law.scu.edu/lawreview/vol41/iss4/6 (last retrieved 3 Mar 2014), and A E Kaloyares, "Annie Get Your Gun? An Analysis of Reactionary Gun Control Laws and Their Utter Failure to Protect Americans from Violent Gun Crimes" (March 2013), *Southern University Law Review*, Vol. 40(2),. available at SSRN: http://ssrn.com/abstract=2251996 (last retrieved 3 Mar 2014)

106 M Nussbaum, *Hiding from Humanity: Disgust, Shame, and the Law*, (2004), Princeton University Press.

107 *Supra* note 9, citing L Kass, "The Wisdom of Repugnance", (2 June 1997), *The New Republic*, 216(22), 17-26.

108 *Supra* note 9, at 111.

should the scientific and ethical merits be analysed.[109] Regarding the oft-utilised argument against "unnatural" research, they see this as weak and lacking a clear definition as to what "natural" means and when it is in fact appropriate to act "unnaturally". One can easily extend this argument *ad absurdum* "[a]re earthquakes and tornados good? Are human prevention strategies and technologies to cope with them bad?"[110]

Conclusion

It seems that such research is likely to continue, and scientific, particularly medical, developments either directly or indirectly resulting from such work could possibly be of great help to humanity. As it stands, the UK has quite a liberal model that balances scientific freedom with licensing oversight, despite public concerns and fierce debate. This is all the more impressive as the discussion in this area remains mired in a lack of information, misunderstandings and reactionary attitudes often based simply on deep negative societal attitudes towards terms such as "hybrid" or "chimera". Perhaps if one named these entities after more historically popular, or revered, characters, rather than the beasts of science fiction and mythology - hybrids could be 'hanumans'[111] and chimeras 'horuses'[112] - we would have less trouble in this area of science. One of the strategies adopted to keep scientific policy democratic but also comparatively well-informed is to have 'lay-people' on ethics and regulatory boards, introducing a vital non-expert, but well informed facet to oversight in these areas. In the UK, local ethical review processes are used to evaluate research proposals from laboratory scientists and many include lay members.[113] Finally, this field could benefit vastly from better education of the public on the realities of such research, as well as more restraint and less exaggeration from the media on both sides.

[109] *Supra* note 73, at 823.

[110] *Ibid*.

[111] Hindu monkey-god. Resembles more what a hybrid human-non-human-primate might look like than other traditional animal-anthropomorphic gods, which are generally closer to the chimera category - having distinctly human features and distinctly animal ones. See *supra* note 11.

[112] Egyptian falcon-headed god. See *supra* note 11.

[113] *Supra* note 95, at 48.

BIBLIOGRAPHY

Books

1. E Garrard and S Wilkinson, "Mind the gap: the use of empirical evidence in bioethics", in M Hayry, T Takala and P Herissone-Kelly, eds, *Bioethics and social reality*, (2005), Rodopi, Amsterdam, 73-87,
2. J Marks, "98% Chimpanzee and 35% Daffodil: The Human Genome in Evolutionary and Cultural Context", In *Genetic Nature/Culture: Anthropology and Science beyond the Two-Culture Divide*, (2003), eds A Goodman, D Heath and M S Lindee, University of California Press, Berkeley, CA, 132-152,
3. S McLean and L Williamson, *Xenotransplantation: Law and Ethics*, (2005), Ashgate,
4. M Nussbaum, *Hiding from Humanity: Disgust, Shame, and the Law*, (2004), Princeton University Press,
5. Vercors, You Shall Know Them, (1953), translated by Rita Barisse, Boston: Little, Brown.

Articles

1. F W Allendorf et al, "The problems with hybrids: setting conservation guidelines", (November 2001), *Trends in Ecology & Evolution,* Vol 16(11), 613-622. doi:10.1016/S0169-5347(01)02290-X
2. E Balaban, M A Teillet, N Le Douarin, "Application of the quail-chick chimera system to the study of brain development and behavior", (9 Sep 1988), *Science*, Vol 241(4871), 1339-1342. doi: 10.1126/science.3413496
3. A Bhan, P A Singer and A S Daar, "Human-animal chimeras for vaccine development: an endangered species or opportunity for the developing world?", (May 2010), BMC International Health and Human Rights, Vol 10(8), doi:10.1186/1472-698X-10-8
4. J A Byrne et al, "Producing primate embryonic stem cells by somatic cell nuclear transfer", (22 Nov 2007), *Nature,* Vol 450(7169), 497-502,
5. S Camporesi, G Boniolo, "Fearing a non-existing Minotaur? The ethical challenges of research on cytoplasmic hybrid embryos", (2008), *J Med Ethics*, Vol 34, 821–825. doi:10.1136/jme.2008.024877
6. P A De Sousa et al, "Somatic cell nuclear transfer in the pig: control of pronuclear formation and integration with improved methods for activation and maintenance of pregnancy", (2002), *Biol Reprod*, Vol 66, 642-650,
7. O D Duncan, L F Parmelee, "Trends in public approval of euthanasia and suicide in the US, 1947–2003", (2006), *J Med Ethics*, Vol 32, 266-272,
8. H Gottweis, S Minger, "iPS cells and the politics of promise", (2008), *Nat Biotechnol*, Vol 26, 271-272,
9. C G Groth et al, "Clinical aspects and perspectives in islet xenotransplantation", *J Hepatobiliary Pancreat Surg,* (2000), 7(4), 364-369,
10. P Hobson-West, "The role of 'public opinion' in the UK animal research debate", (2010), *J Med Ethics*, Vol 36, 46-49. doi:10.1136/jme.2009.030817,
11. R M Isasi et al, "Legal and Ethical Approaches to Stem Cell and Cloning Research: A Comparative Analysis of Policies in Latin America, Asia, and Africa", (Dec 2004), The Journal of Law, Medicine & Ethics, Vol 32(4), 626-640.
12. N Johnson, "Hybrid incompatibility and speciation", (2008), *Nature Education* , 1(1),
13. D A Jones, "What does the British public think about human–animal hybrid embryos?" (2009), *J Med Ethics*, Vol 35,168-170 doi:10.1136/jme.2008.026336
14. A E Kaloyares, "Annie Get Your Gun? An Analysis of Reactionary Gun Control Laws and Their Utter Failure to Protect Americans from Violent Gun Crimes" (March 2013), *Southern University Law Review*, Vol. 40(2),. available at SSRN: http://ssrn.com/abstract=2251996 (last retrieved 3 Mar 2014)
15. P Karpowicz, C B Cohen and D J Van der Kooy, "Developing Human-Nonhuman Chimeras in Human Stem Cell Research: Ethical Issues and Boundaries", (June 2005), *Kennedy Institute of Ethics Journal,* Vol 15(2), 107-134. doi: 10.1353/ken.2005.0015

16. L Kass, "The Wisdom of Repugnance", (2 June 1997), *The New Republic*, 216(22), 17-26,
17. B Lander et al, "Harnessing Stem Cells for Health Needs in India", (Jul 2008), Cell Stem Cell, Vol 3(1), 11-15
18. M W Lensch et al, "Teratoma Formation Assays with Human Embryonic Stem Cells: A Rationale for One Type of Human-Animal Chimera", (13 Sep 2007), *Cell Stem Cell*, Vol 1(3), 253-258,
19. J L Leroy, "Current Priorities in Health Research Funding and Lack of Impact on the Number of Child Deaths per Year", (Feb 2007), *Am J Public Health*, Vol 97(2), 219–223. doi: 10.2105/AJPH.2005.083287
20. S Lundin and H Widner "Attitudes to Xenotransplantation: Interviews With Patients Suffering From Parkinson's Disease Focusing on the Conception of Risk", (Aug 2002) *Transplant Proc*, 32(5), 1175-1176
21. S Lundin, "Creating identity with biotechnology: The xenotransplanted body as the norm", (2002), *Public Understanding of Science*, 11(4), 333-345,
22. S Lundin, "The boundless body: Cultural perspectives on xenotransplantation", (1999) *Ethnos: Journal of Anthropology*, 64(1), 5-31,
23. R A Manji et al, "Porcine bioprosthetic heart valves: The next generation", (Aug 2012), *Am Heart Journal*, 164(2),177-185. doi: 10.1016/j.ahj.2012.05.011
24. L J Martin, "Transgenic mice with human mutant genes causing Parkinson's disease and amyotrophic lateral sclerosis provide common insight into mechanisms of motor neuron selective vulnerability to degeneration", (2007), *Rev Neurosci*, 18(2), 115-136
25. M G Michaels et al, "Baboon bone-marrow xenotransplant in a patient with advanced HIV disease: case report and 8-year follow-up." *Transplantation*, (15 Dec 2004), 78(11), 1582-1589,
26. K P. Miller, "Constraining Populism: The Real Challenge of Initiative Reform", Symposium,(2001) Santa Clara L. Rev. Vol 41, available at http://digitalcommons.law.scu.edu/lawreview/vol41/iss4/6 (last retrieved 3 Mar 2014)
27. Y Neng et al, "Disputed Maternity Leading to Identification of Tetragametic Chimerism", (16 May 2002), *New England Journal of Medicine*, 346(20): 1545–1552. doi:10.1056/NEJMoa013452
28. K Rossiianov, "Beyond Species: Il'ya Ivanov and His Experiments on Cross-Breeding Humans with Anthropoid Apes", (June 2002), *Science in Context* , Vol 15(2), 277-316. doi: 10.1017/S0269889702000455
29. A H Skelly and A R Van Son, "Insulin allergy in clinical practice", (Apr 1987), *Nurse Pract*, Vol 12(4), 14-18,
30. K Takahashi , S Yamanaka, "Induction of pluripotent stem cells from mouse embryonic and adult fibroblast cultures by defined factors", (2006), *Cell,* Vol 126, 663-676.
31. B R Underwood et al, "Huntington disease patients and transgenic mice have similar pro-catabolic serum metabolite profiles", (Apr 2006), *Brain*, Vol 129(4), 877-886,
32. H Y Vanderpool, "Xenotransplantation: progress and promise", (13 Nov1999), *BMJ*, 319(7220), 1311,
33. J Wright, book review of; S McLean and L Williamson, *Xenotransplantation: Law and Ethics*; (Dec 2006), *SCRIPTed*, Vol 3(4), 491-492, doi: 10.2966/scrip.030406.491
34. Practice Committee of the American Society for Reproductive Medicine, "Ovarian hyperstimulation syndrome", (Nov 2008), *Fertil Steril*, 90(5 Suppl), 188-193. doi: 10.1016/j.fertnstert.2008.08.034

Statutes, Consultations and Reports

1. FRAME, "FRAME Chairman warns UK should invest more in adult stem cell research", (4 Jun 2010), *Fund for the Replacement of Animals in Medical Experiments: Press Release*,
2. HFEA, "Hybrids and Chimeras: A consultation on the ethical and social implications of creating human/animal embryos in research", (Apr 2007), *Human Fertilisation and Embryology Authority*,
3. *House of Commons Parliamentary Debates*, 19 May 2008,

4. House of Commons Science and Technology Committee (SCT), "Fifth report of session 2006–07. Government proposals for the regulation of hybrid and chimera embryos", (2007), Stationery Office, London, (HC 272-I),
5. Human Fertilisation and Embryology Authority (HFEA), "Hybrids and Chimeras: A report on the findings of the consultation ", (2007), HFEA, London
6. Human Fertilisation and Embryology Act 1990,
7. Human Fertilisation and Embryology Act 2008,
8. The Wellcome Trust and Medical Research Council, "Evidence from the Medical Research Council and the Wellcome Trust", (22 Jan 2007), House of Commons Science and Technology Committee,
9. UKXIRA, "Summary Notes of Thirty-Second Meeting", (9 May 2006),

News, Websites and Blogs

1. M Adams, "A real Planet of the Apes? UK scientists secretly grew human-animal hybrids in laboratory experiments", (23 Jul 2011), *NaturalNews.com*, available at; http://www.naturalnews.com/033100_human-animal_hybrids_Planet_of_the_Apes.html#ixzz2QWkvDHWn
2. A Barton, "How high-profile causes like Movember push less 'sexy' ones aside", (11 Nov 2012), *The Globe and Mail*, available at http://www.theglobeandmail.com/life/how-high-profile-causes-like-movember-push-less-sexy-ones-aside/article5161556/
3. BBC, "Peer and Church clash on embryos", (4 March 2008), *BBC News*, available at http://news.bbc.co.uk/1/hi/uk_politics/7310918.stm
4. BBC News Sci/Tech, "The history of xenotransplantation", (19 Aug 1999), *BBC News*, available at http://news.bbc.co.uk/1/hi/sci/tech/425120.stm
5. D Derbyshire, "Beware 'Planet of the Apes' experiments that could create sci-fi nightmare", (22 Jul 2011), *Daily Mail Online*, available at; http://www.dailymail.co.uk/sciencetech/article-2017475/Beware-Planet-Apes-experiments-create-sci-fi-nightmare.html
6. Aaron Dykes and Alex Jones, "Genetic Genocide: Humanity's Greatest Threat", (27 July 2011), *Infowars.com*, available at; http://www.infowars.com/?p=58728
7. E Inglss-Arkell, "The Virus that Inspired the Whole Zombie Genre", (19 Jun 2012), *i09*, available at http://io9.com/5919645/the-virus-that-inspired-the-whole-zombie-genre (last retrieved 3 Mar 2014)
8. B Hirschler, "New rules urged on hybrid animal-human experiments", (21 Jul 2011), Reuters, available at http://www.reuters.com/article/2011/07/21/us-science-animal-human-idUSTRE76K7Q220110721 (last retrieved 3 Mar 2014)
9. Huffington Post, "Cardinal Keith O'Brien Sex Scandal 'A Serious Blow' To Catholic Church In Scotland", (Mar 2013), Huffingtonpost.co.uk, available at http://www.huffingtonpost.co.uk/2013/03/04/cardinal-keith-obrien-sex-scandal-catholic-church-scotland_n_2807423.html (last retrieved 3 Mar 2014)
10. E M Johnson, "Scientific Ethics and Stalin's Ape-Man Superwarriors", (10 Nov 2011), *Scientific American: Blogs*, available at http://blogs.scientificamerican.com/primate-diaries/2011/11/10/stalins-ape-man-superwarriors/ (last retrieved 3 Mar 2014),
11. Matrix BioScience, "BSE Risk-Management", *MatrixBioScience.com,* available at http://www.matrixbioscience.com/en/products/collagens-overviewhtml/bse-risk-management.html
12. K Than, ""Zombie Virus" Possible via Rabies-Flu Hybrid?", (27 Oct 2010), National Geographic News, available at http://news.nationalgeographic.com/news/2010/10/1001027-rabies-influenza-zombie-virus-science/ (last retrieved 3 Mar 2014)
13. PharmaXChange, "The Ageing Skin - Part 4e - Dermal Fillers", (9 Mar 2011), *pharmaxchange.info*, available at http://pharmaxchange.info/press/2011/03/the-ageing-skin-part-4e-dermal-fillers/
14. K Ravilious, "Chemistry Nobel Prize Awarded for Glowing Protein Work", (8 Oct 2008), *National Geographic News*, available at http://news.nationalgeographic.com/news/2008/10/081008-nobel-chemistry.html

15. M Rodriguez, "Chimeras, Mosaics, and Other Fun Stuff", (20 June 2007), *The Tech,* available at; http://genetics.thetech.org/ask/ask225
16. L Skene and J Savulescu, "The Ethics of 'Human Admixed Embryos': Concerns and Responses", (19 May 2008), *University of Oxford: Practical Ethics Blog*, available at; http://blog.practicalethics.ox.ac.uk/2008/05/the-ethics-of-human-admixed-embryos-concerns-and-responses/
17. The Jackson Laboratory, "Huntington's Disease Mouse Model To Be Distributed By Jackson Laboratory", (2 Apr 1997), *Science Daily*, available at; http://www.sciencedaily.com/releases/1997/04/970402124046.htm
18. N Wade, "Stem Cell Mixing May Form a Human-Mouse Hybrid", (27 Nov 2002) *The New York Times*, available at; http://www.nytimes.com/2002/11/27/science/27CELL.html
19. R Weiss, "Of Mice, Men and In-Between: Scientists Debate Blending Of Human, Animal Forms", (20 Nov 2004), *The Washington Post*, available at; http://www.washingtonpost.com/wp-dyn/articles/A63731-2004Nov19.html

Shane Patrick McNamee

Humano-animalni hibridi i himere: „Što ima u nazivu?"

SAŽETAK

Ovaj rad nastoji analizirati javno mišljenje i razumijevanje istraživanja o humano-animalnim hibridima i himerama, području u kojem postoje osobito jaka mišljenja i reakcije, ali moguće relativno malo razumijevanja ili efikasne komunikacije s javnosti. Rad počinje pregledom mitoloških, povijesnih i znanstveno-fantastičnih konotacija ovih pojmova. Rad razjašnjava razmjere ovakvog istraživanja i onoga što se točno podrazumijeva pod pojedinim pojmovima (kao što su ksenotransplantati, transgenetika, hibridi, himere). Slučajevi miješanih embrija u Ujedinjenom Kraljevstvu istražuju se kao prikaz slučaja te se pokazuje kako senzacionalizam u izvještavanju na obje strane debate može dovesti to regulatornih poteškoća. Konačno, ovaj rad bavi se utjecajem ove teme na javnu politiku i propise u Ujedinjenom Kraljevstvu.

Ključne riječi: hibridi, himere, transgenetika, ksenotransplantacija, cybridi, miješani embriji, javne politike, medicinski propisi