



Do human-animal hybrids and chimeras mean the abolition of man?

*Agneta Sutton**

Resumen

Los científicos del Reino Unido están intentando conseguir permiso para crear híbridos humano-animales a través de la clonación. Lo anterior, dada la escasez de óvulos humanos para crear embriones para la investigación con células troncales obtenidas de embriones humanos. La idea es utilizar óvulos de vaca o de coneja en lugar de óvulos humanos para clonar embriones que serían 99% humanos y 1% animales. El núcleo del óvulo animal sería removido y reemplazado por un núcleo celular humano.

Estos proyectos generan preguntas morales y metafísicas. Generan la pregunta sobre qué quiere decir ser humano. Y generan la pregunta de si es moralmente legítimo remover el límite existente que separa a los humanos de (otros) animales.

Este trabajo discute el estatuto de los híbridos humano-animales creados por clonación, utilizando óvulos animales en lugar de óvulos humanos para crear embriones clonados casi humanos. Discute además el estatuto de embriones, y otras criaturas más maduras, cuyos cuerpos están compuestos de células o tejidos, ambos de origen humano y animal.

No es la primera vez que las nuevas tecnologías reproductivas nos enfrentan a nuevas decisiones. La ciencia avanza rápi-

* Senior Lecturer, Department of Theology, University of Chichester (address for correspondence: agneta.sutton@gmail.com).



damente. Está en su propio momento. Pero, ¿podemos dejar que todo lo que se puede hacer, se haga? Seguramente deberá prevalecer la razón y el respeto hacia el ser humano; de otra manera crearemos un mundo en el que algunos seres humanos tendrán un compromiso biológico que los harán menos humanos que otros.

Summary

Scientists in the UK are seeking to obtain permission to create human-animal hybrids by means of cloning. This is because there is a shortage of human eggs to create embryos for human embryonic stem-cell research. The idea is to use rabbit or cow eggs instead of human eggs to clone embryos that would be 99% human and 1 % animal. The nucleus of an animal egg would be removed and replaced by a human cell nucleus.

These projects raise both moral and metaphysical questions. They raise the question of what it means to be human. And they raise the question of whether it is morally legitimate to remove the Rubicon that separates humans from (other) animals.

This paper discusses the status of human-animal hybrids created by cloning, using animal eggs instead of human eggs to create near-human cloned embryos. It also discusses the status of embryos and more mature creatures whose bodies are composed of cells, or tissues, of both human and animal origin.

This is not the first time that new reproductive technologies face us with new choices. Science is moving fast. It has a momentum of its own. But can we afford to allow anything that can be done to be done? Surely, reason and respect for the human being must prevail, lest we create a world in which some humans will be biologically compromised and less human than the rest.

Palabras clave: quimera, híbrido, embriones humano-animales, clon.
Key words: chimera, hybrid, clone, human-animal embryos.



Introduction

With his creative work the *Abolition of Man*, first published in 1944, C.S. Lewis, one of the most influential English Christian writers of his days, questioned science's attempt to reduce man to mere "nature" and treat humanity as mere raw material. He spoke of a de-humanized science with little, or no, respect for our humanity and human nature. He expressed fears that in their quest to conquer nature and master it, scientists would treat future creatures of human origin in a less than benevolent way in order to suit their own scientific ambitions. Reading him today, his words have a prophetic ring.

All embryo research involving the destruction of human embryos treats the human embryo as mere material. But, until quite recently, there had been few attempts to create multi-cell embryos and fetuses containing either both animal and human cells or cells that are both human and animal in their genetic make-up. Today, however, scientists in different parts of the world are seeking to do just this, and some of them are succeeding. We are facing the creation of cross-species creatures, partly animal and partly human.

We stand –yet again– at a point where the road divides. The question is: Do we walk this way or that way? Some have already walked down one avenue; and others are set to follow. Seeking to halt their march may be a vain effort. Yet we should take time to think about the implications of what they are doing who, in the name of science and for the sake of medical progress, are willing to create sub-human creatures. We cannot ignore the developments in this area of research. The ventures on which scientists are embarking when creating sub-human creatures raise both moral and metaphysical questions.¹

Three UK applications to create human-animal embryos

Unable to obtain enough human eggs for cloning for human embryonic stem-cell (hES) research, three UK teams, on October 2006, let it be publicly known that they intend to submit simultaneous applications to the UK's Human Fertilisation and Embryology Authority



A. SUTTON

(HFEA), seeking licenses to create human-animal hybrid embryos. The three teams, one in London, one in Edinburgh and one in Newcastle, have been encouraged by the HFEA, the body regulating embryo research in the UK. And the HFEA itself is taking legal advice about the possibility of granting licenses. The embryos in question would be 99,9% human and 0,1 % rabbit or cow. Thus instead of using human eggs in order to create cloned human embryos, the scientists are hoping to use rabbit or cow eggs.

If successful, their applications will allow them to remove the nuclei from rabbit or cow eggs and replace them with human-somatic-cell nuclei. That is to say, the process is the same as in the case of conventional cloning, also called somatic cell-nuclear transfer (SCNT). And so the aim is to create embryos containing the complete set of human somatic-cell-nucleus genes (i.e., the complete set of human chromosomes found in the human somatic cell nucleus), plus a multitude of animal genes located in the energy-making structures of the enucleated rabbit or cow egg's mitochondria.

The two teams, led by professor Stephen Minger at King's College, University of London, and Professor Ian Wilmut, the well known Edinburgh University scientist whose team created Dolly the world's first cloned sheep, intend to use the cloned embryos to obtain human embryonic stem cells carrying the genetic defects causing neurological conditions such as motor neurone disease. Thus by converting the embryonic stem cells to neural cells they hope to discover why, and how, such diseases destroy the nerves. This is with the further hope of paving the way for the production of drugs that halt or reverse the neural damage.

Led by Alison Murdock the team at the Newcastle Fertility Centre for Life, part of the University of Newcastle, is hoping to insert human skin cells into animal eggs in order to study the process whereby eggs re-programme adult somatic-cell-nuclear genes and make them revert to the primitive embryonic stage. However, all the teams are still awaiting approval from the HFEA which has started a public consultation.

As to the feasibility of the creation of rabbit-human embryos, such embryos have already been successfully created. In 2003, scientists at Shanghai Second Medical University reported that they had created



some 400 human-rabbit hybrids and that 100 of them continued growing for about 4-5 days, that is, to around the 100-cell stage.

Definitions and the legal status of human-animal chimeras and hybrids

Given the legal situation in the UK, the aforementioned proposals might not involve illegal procedures. The HFE Act 1990 forbids the placing of a human embryo in an animal, or in an animal cell. It also forbids the placing of a non-human embryo in a woman as well as the placing of non-human gametes in a woman. This bears witness to a common revulsion to the idea of sexual involvement with animals and to the creation of half-human creatures.

However, while the placing of a human embryo in an animal cell is forbidden, the HFEA allows the testing of male fertility by means of the “hamster test”. This test –now seldom used because of the availability of intracytoplasmic sperm injection (IcsI)– involves fertilising hamster eggs with human sperm and allowing the development of a two-cell embryo. This is a procedure many other countries forbid.

Moreover, there is no explicit legal obstacle to the creation of an embryo by placing a human-somatic-cell nucleus in an enucleated animal egg. The law is silent on this point. The HFE Act 1990 does not cover the whole field of reproductive possibilities. Science has moved on and many of the procedures now on the horizon were not envisaged in 1990.

Hence, there is talk of revision. And it should be noted that, if the HFE Act 1990 is revised or amended, it is far from certain that the UK law regulating embryo research will become more, rather than less, restrictive. In paragraph 60, of the House of Commons Science and Technology Committee report, of March 2005, *Human Reproductive Technologies and the Law*, it was actually suggested that embryos left over after IVF might be placed in animals for research into causes of miscarriage and infertility. And ‘the Governments report, *The Government Response to the House of Commons Science and Technology Committee, Human Reproductive Technologies and the Law*, of



A. SUTTON

August 2005, does not rule out the possibility that the law will be changed in this direction. In its Recommendation 7, it says that ‘if scientists and clinicians were able to provide convincing justification for any change, this should be determined by Parliament’.

However, if the aforementioned UK applications for licences to create human-rabbit or human-cow embryos are successful, they will be subject to the 14-day limit to embryo research stipulated by the 1990 Act. This means that the embryos created with the use of cow or rabbit egg will not be allowed to develop for more than 14 days. But while the 14-day limit will have to be respected, there remains a degree of uncertainty concerning the UK law with regard to the creation of human-animal chimeras and hybrids. This was precisely why the House of Commons Science and Technology Committee report considered, among other issues, that of the production of human-animal chimeras and hybrids. Proposing clarification of the legal status of these entities, the Committee, in paragraph 66 of its report, put forward the following three recommendations: first, new legislation should define the nature of these human-animal chimeras and hybrids; secondly, it should make the creation of these creatures legal for research purposes, provided they are destroyed within the current 14-day rule for human embryo cultures; and thirdly, it should prohibit their implantation in a woman.

The Committee also, in paragraph 64 of the report, proposed the following definitions, based on definitions of chimeras and hybrids found in Canadian law: a *chimera* is: an embryo into which a cell of any non-human life form has been introduced; or an embryo that consists of cells of more than one embryo, foetus or human being; a *hybrid* is: a human ovum that has been fertilised by a sperm of a non-human life form; an ovum of a non-human life form that has been fertilised by a human sperm; a human ovum into which the nucleus of a cell of a non-human life form has been introduced; an ovum of a non-human life form into which the nucleus of a human cell has been introduced; or a human ovum or an ovum of a non-human life form that otherwise contains haploid set of chromosomes from both a human being and a non-human life form.

Commenting on the scientific development, and given these discussions about changes to the UK law governing embryo research,



DO HUMAN-ANIMAL HYBRIDS AND CHIMERAS MEAN THE ABOLITION OF MAN?

the Scottish Council on Human Bioethics, an independent thinktank, produced a report in the summer of 2006. This report, entitled *Embryonic, Fetal and Post-natal Animal Human Mixtures: An Ethical Discussion*, presents an overview of work presently undertaken with human-animal chimeras and hybrids and calls on national governments and international bodies such as the Council of Europe to wake up to this fast developing field of research.

In the report we also find the following, more specific, definitions of the entities we are talking about.

— An embryonic and foetal animal-human chimera is: “a human embryo or foetus into which at least one cell of a non-human life form has been introduced; or an animal embryo or foetus into which at least one cell of a human life form has been introduced”.

— And a post-natal animal-human chimera is “a human person in which animal cells, tissue or organs have been transplanted (this is defined as xeno-transplantation) (...) or an animal in which human cells, tissue or organs have been transplanted”.

— An animal-human hybrid is “a biological organism created through the general use of eggs and sperm cells of different animal and human origins”. These include:

a. a human ovum that has been fertilised by sperm of a non-human life form; *b.* an ovum of a non-human life form that has been fertilised by a human sperm; *c.* a human ovum into which the nucleus of a cell from a non-human life form has been introduced; *d.* an ovum of a non-human life form into which the nucleus of a human cell has been introduced; *e.* a human ovum or an ovum of a non-human life form that otherwise contains chromosomes from both a human being and a non-human life form.

In shorter and simpler terms, a chimera, then, is an organism that is made up of cells with different genetic make-up. Thus in a human-animal chimera some cells would have a human genetic make-up while other cells would have an animal genetic make-up. There would be two distinct species-type of cell. A hybrid, on the other hand, created by cloning or by fertilisation involving egg and sperm or created by some other means, would contain a mixture of animal and human DNA in all its cells. That is, all its cells would contain mixed-species genes.



A. SUTTON

It may be observed that in regard to the moral status of chimeras and hybrids, the House of Commons Science and Technology Committee, in paragraph 66, stated that, while the issue is complex, these entities “are less human than, and therefore pose fewer ethical problems for research than fully human embryos”. But, as argued below, this is a moot point.

Finally, it might be added that the House of Commons Science and Technology Committee’s recommendations concerning the legal status of human-animal chimeras and hybrids were accepted, and repeated, more or less, *verbatim*, in Recommendation 9, in the *Government Response to the Report from the House of Commons Science and Technology Committee: Human Reproductive Technologies and the Law*.

The moral status of human-animal hybrids and chimeras

Since research involving human-animal chimeras and hybrids is novel, to date there has been little detailed and probing consideration of the moral issues involved. The aforementioned response produced by the Scottish Council on Human Bioethics is herefore a pioneering work in this area. Noting that bestiality has always been regarded as below human dignity and is considered a criminal activity in many countries, and that in the UK bestiality is prohibited under the Sexual Offences Act 2003, the Scottish Council on Human Bioethics cautions against the creation of chimeras and hybrids, spelling out 14 carefully drafted recommendations.²

Basically, these recommendations rule out the creation of human-like animals as well as the creation of humans gestated by animals and animals gestated by humans.

Thus, while voicing concern about biomedical risks relating to the development of chimeras and hybrids as well as concerns about the risks of creating new diseases as a result of animal retro-viruses crossing the species barrier, the Council, under paragraph 4 in its document, voiced the concern that the creation of human-animal chimeras and hybrids means that the definition of “being human” no longer is clear cut.



DO HUMAN-ANIMAL HYBRIDS AND CHIMERAS MEAN THE ABOLITION OF MAN?

Pointing to the Judeo-Christian tradition, the Council also noted, under paragraph 4.1, that, on a Biblical understanding, humans have a special status and have been given stewardship over the rest of creation.

This is, indeed, the case. On the Judeo-Christian understanding, it is because human beings are created in the image of God and are His Covenant partners that they have been delegated the responsibility to care for creation. So seen, humans have a “stewardly” responsibility before God both to protect human dignity and to respectfully care for and use other creatures. But how, on this understanding, are half human creatures to be regarded? And how dare we mark or diminish the human likeness to God by creating sub-human creatures? On the understanding of ourselves as special and in the image of God, there are limits to what we should or should not do with ourselves and other creatures.

It should be added that it is not only people belonging to the Judeo-Christian tradition of thinking who regard humans as having a special status. Secular society does not ascribe responsibilities to animals. And it would not be normal for us humans to seek out animals for the same kind of companionships as we do other humans. Nor do we accord animals the same rights as humans.

And so the question to be considered here is what we might justifiably do to ourselves and our species as human. This in turn raises a number of sub-questions. First, does it matter if only a gene or two are exchanged between animals and humans? At what stage does a human-animal chimera or hybrid cease to be human? Does it make a difference what type of tissue is involved in the cross-species transfer?

Chimeras

To start with the last question, the idea of post-natal human animal chimeras is not foreign to use Xenotranplantation, as animal-to human transplantation is called, does create post-natal human-animal chimeras. Because of the shortage of human organs for transplantation,



A. SUTTON

attempts are currently being made to produce pigs whose hearts and kidneys may be transplanted to humans. Of course, some may feel revolted at the thought of receiving a pig heart. However, because organs with a purely mechanical function, such as hearts and kidneys, do not alter personality or affect our progeny, but serve a merely mechanical purpose, it may be argued that their use is morally neutral. What is the big difference between their use and the use of human organs? Human-to-human transplants are found acceptable—at least under certain conditions. And apart from the so called yuk-factor and the biomedical risks involved as well as animal welfare concerns, these seems to be no additional moral issues here in regard to animal organs.

The situation may be considered very different in the case of brain tissue and also in the case of reproductive organs or cells. The creation of human-animal chimeras with mainly human appearance but with the typical animal-like behaviour of another species—if it were possible by transfer of animal brain tissue to human embryos, foetus, children or adults to create such creatures—would, on a Judeo-Christian and Biblical understanding, spoil the image of God. And so it would be an insult to both God and humankind.

Even on a secular understanding, that kind of transfer of tissue from animal to human should be a cause for concern. The creation of such sub-humans would be inhuman. These creatures could not, and therefore would not, be treated as our equals. And so their creation might be seen as a contravention of our human rights declarations. It would certainly insult the sensitivity of most of us. To reiterate, after all we are social or relational beings reaching out to others for companionship and love. But how could these subhuman creatures respond to that; and how could we relate to them? We could not recognise them as our brothers and sisters. Indeed, we might see them as a threat to the human community and to our human dignity.

The creation of a creature with the appearance of a mouse or dog, but with distinctly humanlike behaviour would be no less an insult to humankind and to the humanity of the human creature trapped in the animal body. Such experiments with humans would be unbelievably cruel and totally unacceptable from a humanitarian point of view.



DO HUMAN-ANIMAL HYBRIDS AND CHIMERAS MEAN THE ABOLITION OF MAN?

Such experiments would not only contravene human rights declarations and, in the eyes of the Judeo-Christian tradition mar the image of God reflected both in body and mind of the human person, but they would also evoke public feelings of pity, disgust and indignation.

Experiments such as these would constitute an insult to human dignity, because they would convey the message that some humans are less human than most of us, even if they are like most of us in every respect except their bodily appearance. Effectively, 'experiments such as these would constitute a new kind racial discrimination.

And yet might such creatures as these nonetheless be created? In March 2005, a team headed by Professor Irving Weissman, at Stanford University in the United States, announced that they had injected human brain cells into mouse foetuses, creating mice embryos whose brains were approximately 1 % human. The team now wants to inject human brain-stem-cells affected by Parkinson's disease and other neurological conditions into mice foetuses. This is, of course, in order to study these diseases. Not content with this, the Stanford team is also planning to create mice with brains composed almost completely of human brain cells. And their proposal has already been endorsed by an informal ethics committee. This is with the (only) caveat that, if the mice start showing human-like behaviour, they should be killed immediately. This precaution will hardly reassure all of us.

Not that it is likely that a human brain would form within a mouse cranium. But the thought of a self-conscious, more or less rational, creature with, more or less, human emotions being trapped in the body of a mouse is a grim thought. Created because it has pleased some scientists to create him, the human mouse would have cause to consider its human makers to be irreverent and lacking in respect both for the human species and for his personal humanity.

Equally inhuman would it be to transfer human germ-line cells to a breed of animals in order for these cells to develop in the animal testes or ovaries so as to allow the animals to conceive and breed humans. Human beings have the right to be the offspring of humans. This is because being the offspring of humans is part of what we un-



A. SUTTON

derstand by being human. In fact, precisely this is implicitly recognised by the UK prohibition to place a human embryo in an animal to be gestated. To deprive some humans of the right to be born by a woman would be to deprive them of a full sense of human identity. Having animal parents they could not feel fully human. Their loss would not only be psychological and social. It would also be a moral loss, since their human dignity would be insulted. Humans have a different status than animals, and even more so than disposable objects. But being conceived and born by animals, albeit as a result of the coupling of human gametes, is not to be treated as a human. It is to be treated as an experimental product. It is to be subject to the instrumental vain-glory of science. As for the converse, the gestation of an animal by a woman, it is so unlikely that it may be left to the side.

Hybrids

To turn now to hybrids, we have already witnessed the creation of animals with human genes. There are, for example, sheep and goats, which can express foreign proteins in their milk. These animals, which have had foreign genes inserted in their genome may be of use to the pharmaceutical industry. And as mentioned above, pigs are being created with a view to using them as organ donors-in the future when the problem of tissue rejection has been eliminated. These are pigs with human genes which are passed on to subsequent generations. Should these sheep, goats and pigs worry us? No, there is no reason why their existence should worry us, unless they are treated badly. They remain as sheep and goat and pig-like as before both in appearance and behaviour.

Moreover and more important, as noted in the aforementioned Scottish document, it is a moot point whether the genes in question, which programme the production of foreign proteins, should be identified as specifically human. We are talking about tiny bits of DNA, which replicate the work of a human gene. No human material might actually be transferred.

More controversial is the creation of an animal-human hybrid by the transfer of a whole human chromosome. In 2005, UK scientists



DO HUMAN-ANIMAL HYBRIDS AND CHIMERAS MEAN THE ABOLITION OF MAN?

successfully transplanted the human chromosome-21 into 3-day old mice embryos. The embryos were then implanted into mother mice and born alive with human chromosome-21 in their cells. Furthermore, once these hybrid mice had reached maturity, they were able to pass on the human chromosome-21 to their young.

Perhaps, this scenario does not sound too threatening either. If so, we should ask why? Is it because the one extra chromosome did not seem to affect the mouse nature? The mice with the extra chromosome were not human-like either in appearance or behaviour. However, the Scottish Council on Human Bioethics warns against the creation of human-animal hybrids with human chromosomes. Even one human chromosome is thought one too many. Presumably, this is in view of the question: How many human chromosomes can be transplanted into an animal to create a hybrid before it becomes difficult to decide whether the creature is more human than animal, or more animal than human?

Hybrids created by insertion of human chromosomes in the cell-nuclei of animals may seem acceptable provided the organic appearance of the creature is not human-like, and provided the creature shows no human-like behaviour. But might not a law legalising the creation of hybrids of this kind, take us down a road that is as slippery as it is dangerous? Should we, could we, draw a line at three human chromosomes or four or five?

These questions are pertinent. They are pertinent, because some scientists have already gone down this road. Thus, as noted above, scientists in Shanghai have already cloned hybrid rabbit-human embryos, whose cells contain the full set of human chromosomes. And they are not alone in creating hybrids that are almost totally human. Already in 1999, the American company, Advanced Cell Technologies, announced that it has cloned an embryo by inserting the nucleus of an adult human cell into an enucleated cow egg. And this embryo was allowed to develop for 12 days. To give another example, in September 2003, Professor Panayiotis Zavos -who on occasions have suggested that he has created all-human clones-claimed that he had created human-cow embryos and allowed them to grow to the several hundred cells.



A. SUTTON

They may not necessarily see themselves as taking a dangerous turn. But the three UK teams, which are hoping to get permission from the HFEA to create human-rabbit or human-cow hybrids, are arguably taking a step on the road to what C.S. Lewis calls the abolition of man. He wrote: “Human nature will be the last part of Nature to surrender to Man. The battle will then be won. We shall have “taken the thread of life out of the hand of Clotho” and be henceforth free to make our species whatever we wish. The battle will indeed be won. But who, precisely, will have won it? For the power of Man to make himself what he pleases means, as we have seen, the power of some men to make other man what they please”.³

Of course, for those who do not count human embryonic life as human and personal, and so cannot see any reason why some of us might consider human embryonic research immoral, there is little reason to be concerned about the status of human-animal embryonic hybrids or chimeras. This, as we have seen, was made quite clear by the House of Commons Science and Technology Committee, in their 2005 report. So long as the researchers are not seeking to culture and produce more mature creatures, but remain content to respect the 14-day limit for embryo research, these people would feel quite happy about research involving the creation of human-animal chimeras and hybrids. They would have no problem with this kind of research, even if the creatures created were more human than animal, or almost totally human. They would consider such research to be within the limits of what is morally permissible and no cause for scandal.

For those of us who believe that human and personal life begins at conception the situation is very different. For, if human and personal life begins at conception, the question about the status of human-animal embryonic hybrids is a burning question.

Not only does the creation of human-rabbit embryos with the full human chromosomal complement, mean wielding power over some humans or near-humans, be they embryonic or not, but with the creation of humanised animal-human hybrids the uniqueness of human life is lost. Of course, we humans are but animals. But we are special animals. To cross the species barrier and make some humans less than fully human is an abuse of human life.



DO HUMAN-ANIMAL HYBRIDS AND CHIMERAS MEAN THE ABOLITION OF MAN?

Those who take a different view about the beginning of human life should note that it is not mere sentimentality that makes some of us claim that human life begins at conception. It is logic. For each one of us started life as an embryo. And if the embryo that became who I am now had been destroyed, I would not have lived. They would have killed me. Life must be seen as a whole. You cannot pick a piece of the life history of a human being and say that before-or after-this or that moment he or she did not exist. If I started out as an embryo, that embryo was me. This follows logically. To insist on this is not to present a sentimental rationalisation, it is to present a logical argument.

Conclusion

The creation of human-animal chimeras and hybrids is not only matter for scientists. This is a matter of public concern. In the last decade or two we have witnessed rapid developments in biomedical research. It can be hard for the lay-person and for professionals for other fields to keep up with what is going on. But what is happening in this area of research has ramifications for us all. Hence, it is important to for us to debate and discuss them.

As has been shown above, recent developments in the area of embryo research, and in research involving foetal life, raise serious moral questions. The new ventures that have been considered in this paper pose questions about the moral limits to what we can do to humans by way of altering the biological nature of humans. They pose questions about what it means to be humans. They make us question who we are. And they should make us question where we are going. The issue of the creation of creatures that are less than human, but who are human enough for us to question their moral and biologic status, is an issue that we cannot ignore.

Bibliography

¹ I wish to acknowledge my debt to Calurn McKellar, the author of the Scottish Council on Human Bioethics' report, *Embryonic, Fetal and Post-natal Animal-Human Mixtures: An Ethical Discussion*, published in June 2006. The report has been a valuable source of information and inspiration.



A. SUTTON

² These are to the effect that the placing of human sperm or embryos in an animal should be prohibited, as should the placing of animal sperm or embryos in a woman, and also the creation of embryos containing cells with both human and animal chromosomes, as well as the insertion of a human cell nucleus in an enucleated non-human egg. It is also suggested that the mixing of animal and human gametes should be prohibited as should the incorporation of human pluripotent or totipotent stem cells into a non-human blastocyst or pre-blastocyst embryo and also the incorporation of non-human pluripotent or totipotent stem cells into a human blastocyst or pre-blastocyst embryo. And it is argued that the incorporation of human stemcells into post-natal animals should be allowed only if the cells cannot contribute to the germline or give rise to specifically human brain functions. Likewise, the incorporation of non-human stem cells into a post-blastocyst human embryo should only take place if the cells cannot contribute to the germline or brains.

³ LEWIS S. *The Abolition of Man*. San Francisco: Harper; 2001: 59.