

II. Etymological background and further clarifying remarks concerning chimeras and hybrids

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1. Introduction

Biological and medical research involving techniques and entities commonly called chimeras and hybrids raises not only new scientific questions but also questions about ethical, social, and legal implications of this kind of research. The terms chimera and hybrid are used in many different ways, in various disciplines and contexts, denoting diverse entities – even among scientists these terms are not used univocally. The fact that the language surrounding hybrids and chimeras is not clear, and that these terms stand for different entities naturally has a number of ethical, legal and social implications. It seems that, methodologically, the first necessary step is semantic differentiation and clarification i.e.: what do we mean by the term chimera and hybrid? To which entities do we refer, using these terms? In which context do we use these terms? What are deeper concepts behind different notions of chimera or hybrid?

2. Semantic analysis

a. Chimera as an archetype

The original meaning of the term chimera is a compound of different animals or a configuration of human and animal bodies – as it is known from the Greek mythology.⁵ The primordial Greek mythological Chimera (Χίμαιρα) is a fire-breathing monstrous creature made of parts of various animals: resembling a lion in the forepart, a goat in the middle, and a snake/dragon at the back.⁶ Chimera, the offspring of Typhon and Echidna,⁷ was of a grisly nature. Sighting Chimera was a sign of storms, shipwrecks, and (natural) disasters.

⁵ A worthwhile introduction to the Greek mythology can be provided by Robert Graves (Greek Myths. Garden City/N.Y.: Doubleday 1981 [Baltimore: Penguin Books 1955]).

⁶ Descriptions of chimera vary; in one description, chimera had the body of a goat, the tail of a snake or dragon and the head of a lion; in another description, it had heads of both the goat and lion, with a snake for a tail (in Hesiod's description, chimera has three heads). Nevertheless, in all descriptions it breathed fire from one or more of its heads.

⁷ The origin of Chimera has chimeric features: Typhon was a grisly monster with a hundred dragon's heads; Echidna was another mythological monster: half-woman, half-serpent.

There are five characteristic features of the Chimera:

- 1) a mixture of different species (animals)
- 2) divine origin
- 3) deterrent nature
- 4) causing harm (breathing fire, devastating land)
- 5) removal (Chimera was slain by Bellerophon with the help of another chimeric creature Pegasus – see below).

Ancient Chimera as a mixture (creation) of different animals can be considered a chimerical archetype. In Greek mythology, chimera was not only a goat with a lion's head and a snake's tail. Mythological chimera can be any amalgam of human and animal features but also a mixture of human and god or of animal and god - although the god may look like a human or animal. Greek mythology contains many examples of chimerical mixture of human and animal, e.g., Pan (Πάν), god of shepherds, was a man with hindquarters, legs, and horns of a goat.⁸ As chimerical amalgams of human and animal, the following examples can be mentioned: a mermaid (an aquatic creature with the head and torso of human female and the tail of a fish: half-human, half-fish), a Centaur (a combination of a man and a horse), or a Minotaur (a combination of a man and a bull). Pegasus (a combination of a horse and a bird) can stand as an example of an intraspecific legendary chimera. One part (e. g. the human one) usually remains substantially unchanged except for occasional quantitative limitation – usually to one half. Imprimis, the whole is restricted quantitatively (a qualitative diminishment is not necessary and usually does not arise). For that matter, there is an abundance of human-animal and animal-animal chimeras in all world mythologies.⁹ One could state that the whole of Greek mythology – as well as other mythologies – is grounded on the idea of a chimera.

Despite the fact that ancient chimeras look like humans or like animals, they represent a mixed nature composed of human and animal features or of human and divine features. One nature does not necessarily absorb the other. Rather, they combine and create a new entity which comes out as a combined nature or as an extension of one of them. In other words, one (invisible and empirically not verifi-

⁸ Because Pan's genealogy, having many variations, lies in deep mythic time, probably related to a district of primitive mountain folk of Arcadia – Pan has also analogy in other ancient mythologies (his Roman counterpart is Faunus) – Pan as archaic “pasture god” can be regarded for an archetype of human-animal chimera.

⁹ See C. A. P. Ruck, D. Staples, *The World of Classical Myth*. Durham/NC: Carolina Academic Press 1994; E. M. Thury, M.K. Devinney, *Introduction to Mythology: Contemporary Approaches to Classical and World Myths*. New York: Oxford University Press 2005; R. Willis (ed.), *World Mythology*. New York: H. Holt 1993; K. C. Davis, *World Myths*. New York: Harper Collins Publishers 2005.

able) nature comes to the visible one – so for instance, the nature of a god comes to the animal nature of a bird, and the bird represents a hybrid of animal and god as a bird-god. Is this entity a chimera? If we understand chimera – in a broader sense - as a fusion of (at least two) different natures or substances, then the answer is positive. It seems that people in ancient history, surrounded by (terrestrial and divine) hybrids and chimeras, were not bothered by social, ethical or legal difficulties caused by the fused creations of human and animal or human and divine nature as we are nowadays. Chimeras and hybrids were part of their everyday life. Although they did not call these entities (predominantly gods) chimeras or hybrids (they would be horrified by these terms).¹⁰ However there are some significant differences between ancient and contemporary understanding of chimera: the ancient chimera existed only in the mythological framework while the contemporary chimera is a real entity. Another difference is the notion of chimera: the ancient chimera is a mixture of various species as individuals, the contemporary chimera (and hybrid) is a mixture formed on cellular (respectively on organ) level. Therefore, the precise content of the notion of chimera in present time means something very different from the ancient notion of chimera.

In spite of their chimerical nature, chimeras did not lose their attractiveness but retained its fascinating and archetypical form over the centuries. This is true in our era in particular.¹¹ Are mythological concepts – in some way – present in contemporary biotechnologies? What are the driving ideas that move research and progress forward? Is the idea of crossing species a very ancient and primordial archetype of a chimerical form? Is the old archetype of chimera used now? Is it used unconsciously? Or is there no connection and we are simply facing the ongoing scientific development and new technological methods which have their own internal dynamics?

Indeed, the fusion of two (or more) entities, extending the possibilities of both the human and the animal by combining their features and qualities, is a wonderful ancient vision realised by modern technology. Only a few decades ago, we would have thought of chimeras exclusively as figments of our imagination. What once was possible in fantasy fiction only, became recently possible thanks to technology. When reproductive barriers were removed, the boundaries between species was crossed, and experimental animals produced (e.g., sheep-goat) in the 1980s, we simply pulled out the idea of chimera which had been in our culture since ancient times. Finally, what once was a chimera (a chimerical/legendary entity) became a reality produced not by “divine stock”¹² but by human technology.

¹⁰ See the meaning of the term “hybrid” below (2.d.).

¹¹ Cf. E. Bazopoulou-Kyrkanidou, Chimeric creatures in Greek mythology and reflections in science. In: *American Journal of Medical Genetics*, 2001, 100(1): 66-80.

¹² The Chimera in Homer’s *Iliad* “was of divine stock, not of men”.

In this context one should take into account the fact that every human being is constituted of at least two parts – and this two part constitution does not imply any kind of dualism (as we know it from the time of Plato and Platonism). Rather, it is on the genetic level: two sets of 23 genes (maternal and paternal). Biologically and psychologically, no “pure man” or “pure woman” exists but rather each woman and each man is composed of both masculine and feminine “elements” (without dealing in detail with what these masculine and feminine elements reside in; on the genetic level, chromosomes X and Y). In spite of the fact that human beings predominantly understand themselves either as a man or a woman, some people, experiencing difficulties concerning their gender¹³ identity, do not place themselves so easily into one of these two gender categories. We can distinguish not only a human and an animal nature but also a male and a female nature. From the biological and psychological point of view, it is rather difficult to draw a precise line between men and women. The purpose of this observation, however, is not to open the gender issue in the context of chimera (e.g., transsexuality as chimerism?), but to merely state that to be a human always means to be composed of (at least two) elements, without any possibility to be “reduced” to one of them only – regardless of the troubles that the synthesis may bring. Before dealing with the issue of the interspecies boundaries, we should take into account the fact that there are other boundaries existing within the species (and they are not subspecific boundaries). We know that these intra-specific boundaries exist and sometimes it is very difficult for us to distinguish them and to mark them.

b. Etymological background

Etymologically the word chimera denotes a variety of meanings. In English, the term chimera is associated with notions like phantasm, phantom, delusion, illusion, apparition, pipe dream, a castle in the air, unreal ambition, a fanciful scheme or unreality. The word chimera, especially in its old meaning, also denotes a Harpy, a monster, a bogey or irrational fear. Chimera in our common understanding means something (especially an idea or hope) that is not really possible and can never exist. Chimera is linked with a fantastic, impracticable plan or desire; thus chimera is any (futile) attempt to present impossible.

In Classic Greek χίμαιρα stands for a mythical non-existent being; the adjective χίμαιρικός means chimerical, unreal, fantastic, impossible, utopian.

Etymologically, therefore, there are three main sets of meanings related to chimera:

- *chimera as a monster*
- *chimera as a delusion/phantom/unreality*
- *chimera as an (unrealistic and practically) impossible mixture of two different sources.*

¹³ The term “gender” is here used in a wider sense than “sex” solely, indicating the original meaning of genus.

From an etymological point of view, the term chimera is highly inadequate for the current biotechnological methods and products known as chimeras. Chimeras as biotechnological products are not chimeras at all, they are not utopian or chimerical; they are real, very real entities with clear ontological status. They are not common, frequent, or customary but they are not chimeric. Under a basic semantic assumption that terms (words) have to symbolise things that the words stand for, the use of the word chimera for entities (biotechnological products) such as a pig with human blood or a mouse with human brain does not fit into the common semantic scope of the term “chimera”. A pig with human blood is neither chimeric nor horrendous. Similarly a mouse with one per cent of human brain cells is neither a phantom nor a monster. To call these entities chimeras does not, semantically, make sense. Otherwise we have to, in each individual case when we use the term “chimera”, clearly explain that, in fact, we do not mean chimera though we are saying “chimera” and that we are using this term for a kind of interspecific combination. This does not seem very helpful in normal communication. The only way to prevent linguistic confusion is not to use the term “chimera” for entities that are, in reality, interspecies mixtures. No suitable term is being proposed hereby. Only that the use of the word “chimera” – out of the mythological framework – is, for semantic reasons, criticised as inappropriate and misleading.

Beside the semantic inappropriateness, in general, any human activity related to chimera or to chimerical goals has some ethical connotation which also includes moral relevance (e.g., moral judgement about act/behaviour in the relation to chimera).

c. Chimera as a metaphor and as a terminus technicus

The term chimera, having (historically) been used in many different contexts (in Medieval logic “chimera” was used as the word signifying “nothing”; in Christian art, chimera has been used as a symbol of Satanic forces),¹⁴ has become a metaphor, denoting things that have combined attributes from different sources. This metaphorical use of chimera has been transformed into *terminus technicus* in science, especially in zoology, botany, palaeontology, genetics, biochemistry, and – as far technological procedures are concerned – in biotechnology generally. In a wider sense, a chimera is also an individual, an organ, or a part consisting of tissues of diverse genetic constitution, produced as a result of organ transplant, grafting, or genetic engineering. Most of the uses of the term chimera (chimera as *terminus technicus*) are related to the metaphor (combination of two or more different genetic sources).

So the term chimera is a *terminus technicus* for:

- a) single plant organism with genetically distinct cells (botany)
- b) single animal organism with genetically distinct cells (zoology).

¹⁴ Cf. L. N. Roberts, A chimera is a chimera. A medieval tautology. In: Journal of the History of Ideas 1960, 21(2): 273-278.

If we apply the two-source metaphor used in biochemistry (chimera as any substance, created from the proteins or genes of two different species) broadly to medicine, then chimera is any individual who has received a transplant of genetically and immunologically different tissue. That would mean that any patient after any (non-auto) transplantation is a chimera, a constitution of two genetically and immunologically different entities. What about extending such a broad definition of chimera to the whole (technological) biomedicine – moving from an organ approach to a cell approach? Is for instance a regenerated heart a chimera?¹⁵ No wonder that chimera as *terminus technicus* used in various medical settings and in biomedical research induces misunderstanding and confusion.¹⁶ The scientific term chimera has originated from the fascinating and mysterious mixture of animal and human as we understand that notion from history. Apart from non-chimerical polysemy of the term chimera,¹⁷ the distinction between chimera and hybrid should as well be introduced. Chimera can be defined as an entity (a mixture) of two or more genetically different types of cells coming from organisms of the same or different species; hybrid as an entity (a mixture) of two (or more) organisms of the same or of different species (intra-specific or interspecific hybrid).

d. Hybrid

Human–animal hybrids as mixtures of two (or more) organisms of different species were common in Greek mythology. Some examples have already been mentioned (Centaur, Minotaur, mermaid, Pan). However, the Classical Greek did not use the term *hybris* for entities called hybrids today because the word *hybris* has very negative connotations (see below). If we apply the introduced chimera-hybrid distinction, then all creatures mentioned as mythological chimeras were hybrids at the same time. So Greek (and world) mythology is a valuable source of all possible hybrids and chimeras. Anyway, the word hybrid would not sound like a neutral description of a grisly monster for Greek speaking people. The word *hybris* in Greek has a variety of (negative) meanings: vainglory, pride, boast, superciliousness, arrogance, profanation, maltreatment, high-handedness, degrade, abuse; other negative moral connotations of the word *hybris* are: debauchery, revelry, offence, malefaction, crime, injustice. *Hybristes* signifies rapist, criminal. In contemporary Greek, *hybris* means dispraise, invective, dishonour. There are not many Greek words that have such a broad palette of negative meanings as the word *hybris*.

¹⁵ Cf. R. Bolli, Regeneration of the human heart – no chimera? In: The New England Journal of Medicine, 2002, 346(1):55-56.

¹⁶ Cf. H. Bok, What's wrong with confusion? In: The American Journal of Bioethics, 2003, 3(3):25-26.

¹⁷ Cf. H. T. Greely, Defining chimeras... and chimeric concerns. In: The American Journal of Bioethics, 2003, 3(3):17-20.

The term hybrid in common English signifies “an animal or plant produced from parents of different breeds or types, something that consists of or comes from a mixture of two or more other things” (Longman Dictionary). This definition does not express the difference between hybrid and chimera as these terms are used in scientific language. It remains a question of language strategy how far we can/should/shall go using the metaphorical language within, otherwise precise, scientific language. In general, the basic question is about the appropriateness of the usage of a metaphor for scientific conduct.

Therewithal, the negative connotations of the word *hybris* in Greek and its (different) common meaning in everyday English, the term hybrid is used in many different disciplines as a *terminus technicus* in a very specific and clearly defined sense – so for instance the term hybrid is used in logic, analytical philosophy, linguistics, technology, chemistry (hybridisation), and biology. In biology, the term hybrid has various meanings:

- the offspring of different species
- the offspring of different genera
- crosses between different species within the same genus (interspecific hybrids)
- crosses between different subspecies within the same species (intra-specific hybrids)
- crosses between different genera (intergeneric hybrids)
- crosses between different populations, breeds or cultivars of a single species (principally in plant breeding)
- in molecular biology, hybrid refers to hybridisation.

Intra-specific and interspecific hybrids are very common in plant and animal breeding. Many agricultural plants grow as hybrids; for plant breeding, hybrids are very effective.

The term hybrid can be used and understood (comparatively) univocally, if used within a clearly defined semantic framework (as biology provides different and clear definitions of the term hybrid).

It seems that neither the term chimera nor the term hybrid properly expresses the scientific reality. Nevertheless, the term hybrid meaning the offspring resulting from cross-breeding of different species is more suitable, because it is more precise; however, by definition, it is limited to cross-breeding of different species or subspecies. No suggestion is being made regarding an appropriate terminology; no alternative terms are being proposed here.

Nevertheless, there are some attempts to use more appropriate terms and to provide a matter-of-fact, correct, neutral, and morally unprejudiced description,

avoiding confusion – for instance the term “creation of novel beings”¹⁸ or “transgenic creatures”¹⁹ (though the appropriateness of these terms is questionable).

e. Some further differentiations

We know what chimera means in Greek mythology. However, we are less sure with respect to the sense(s) in which the term chimera is being used in contemporary biological and biomedical research, including embryonic chimeras.²⁰ In addition, another issue is the usage of the word chimera by the media. Language concerning chimeras used by media will be not analysed here – although it would be worthy to do so. Another hermeneutical community is the general public.

Since one and the same term (chimera) denotes various entities – that apparently have different moral and ethical relevance – it may be useful to make some clarifications by providing some basic differentiations:

a) plant chimera:

- in laboratory
- in nature (e.g., agriculture)

b) animal chimera (experimental)

c) human-animal chimera

d) plant-animal-human chimera

e) human-nonhuman chimera

f) embryonic chimera:

- animal-animal chimera
- human-animal chimera

g) animal/human embryonic chimera:

- on the genetic level
- on the cellular level
- on the tissue/organ level.

Especially with respect to c) to g), different contexts and various goals have to be taken into account and distinguished (e.g., combining human and animal cells to

¹⁸ Cf. J. S. Robert, Regulating the creation of novel beings. In: Health Law Review, 2002, 11(1):14-19.

¹⁹ Cf. L. M. Glenn, When pigs fly? Legal and ethical issues in transgenics and the creation of chimeras. In: Physiologist. 2003, 46(5):251, 253-5 (here 254).

²⁰ Cf. R. A. Ankeny, No real categories, only chimeras and illusions: the interplay between morality and science in debates over embryonic chimeras. In: American Journal of Bioethics, 2003, 3(3):31-33.

study cellular function, transferring a limited number of adult human stem cells into animal embryos in order to learn how they proliferate and grow during the prenatal period, implanting human neurons into the brain of embryonic mice in order to understand better how the brain works, producing human organs,²¹ creating human-animal chimeric body or testing whether adding normal cells to an embryo with a genetic defect could make up for that defect²²).

Another differentiation should be made in chimera usage between basic research and in clinical research. It is obvious that the mentioned examples of chimeras have different moral relevance. We would probably not have many difficulties with moral justification for the second example (to transfer a limited number of adult human stem cells into animal embryos in order to learn how they proliferate and grow during the prenatal period), but we would probably oppose the creation of human-animal chimeric individual. The main concern regarding human-animal chimera is related to the worry whether or not these chimeras will be put to a use that is ethically and medically problematic, risky, or dangerous.

f. Chimera as a strategy

In the debates about human embryonic stem cell research which took place during the last few years, the usage of human embryos for research purposes has been justified by potential benefits (development of new therapies of neurodegenerative and other diseases). The use of embryos for research became very controversial and highly politicised worldwide. Some countries are deeply divided on this issue; researchers in USA and EU are uncertain about public financial support for human embryonic stem cell research. So under the current circumstances, the obvious strategy is to by-pass the (politically and morally) sensitive issue of human embryos by using animal embryos.

Another by-pass strategy, paradoxically, is to avoid usage of animals for research and to use human embryos (especially in countries, where animals have relatively high grade of protection). This means that animals will be not harmed (or killed) through research. In this context, to conduct research on human tissue is less morally sensitive than to conduct research on animals that will be killed afterwards. So this by-pass strategy saves the lives of thousands of laboratory animals. With respect to the other sensitive issue, namely gamete donation, animals could also become very efficient egg donors without the necessity of an informed consent and without the concerns related to potential harm, etc. Another aspect of this by-pass strategy is the use of animal eggs instead of human eggs (advantage of this strat-

²¹ See S. P. Westphal, Growing human organs on the farm. In: New Scientist, 2004, 180(2426-2428): 4-5.

²² Such studies (e. g., obtaining eggs from aborted fetuses or to look if some "method is possible") do not have positive social acceptance, provoking horror by their violation of fundamental human values. Cf. - A. Coglan, Studies provoke shock and horror. In: New Scientist, 2003, 179(2403):19.

egy is evident) for the creation of chimeras. Instead of human embryos, animal embryos can be used and consequently human-nonhuman embryonic chimeras can be created, by going around the hot issue of human embryo usage for research.

3. Anthropological clarifications

a. Chimera and the deeper understanding of humanity

At present, the topic of human and human-animal chimeras is discussed on different levels: among scientists, between the scientific community and the public, in the public, between the scientific community and politicians, etc. There is no wide consent on this issue. Even the scientific community is not unified regarding human-nonhuman chimeras.²³ The situation is more complicated and complex than it was in the view of one of the bio-ethics pioneers, Joseph Fletcher when he wrote in 1980s:

“What if an ape had the intelligence and sensibilities of a human, and a human had only the capabilities of an ape? Which would be the human being? The answer is plain; the ape would be the human being. This is no mere play on words. All mammals, man among them, are remarkably close biologically. Modern biology can devise chimeras or combinations of humans and animals, and also, cyborgs or combinations of humans and machines. [...] The basic fact is that the body cells of all species will cross-fuse, and the germ cells of many – though not all – will unite sexually.

If a prosthetic device, perhaps an intricate mechanical hand or leg, supplies a person with 50 per cent or more of the function lost in an amputation, that is morally good. An artificial kidney or haemodialysis machine is morally good. This applies equally to heart pacemakers, dacron arteries, metal bones, ceramic hip joints. All such technical contrivances are cyborgs or man-machine hybrids.

Man-animal combinations are in the same ethical class. If a cow’s kidney is grown into a patient’s thigh to help cleanse his blood, after his own kidney function is gone, that is morally good. If an animal organ or tissue is used to replace something lost by a human (an interspecific transplant) that is good. These are examples of man-animal combinations for medical purposes. [...] But what about hybridisation for non-medical reasons? Chimeras or parahumans might legitimately be fashioned to do dangerous or demeaning jobs. As it is now, low grade work is showed off on moronic and retarded individuals, the victims of uncontrolled reproduction. Should we not program such workers thoughtfully instead of accidentally, by means of hybridisation? Cell fusion and putting human cell nuclei into

²³ N. DeWitt, Biologists divided over proposal to create human-mouse embryos. In: *Nature*, 2002, 420(6913): 255.

animal tissue is possible (such hybrid tissue exists already as a matter of fact). Hybrids could also be designed by sexual reproduction, as between apes and humans. [...]

Contrived in order to protect human beings from danger or from disease, a medical reason for creating chimeras and cyborgs would be morally justified. What counts is human need and well-being.”²⁴

It would be not fair, from our epistemological state of the art, to criticise a text written almost twenty years ago. In general, we would differentiate more precisely today and even the most liberal proponents of chimeras would have difficulties with the idea of programming low grade workers as slaves by means of hybridisation.

Biotechnological developments and achieved scientific advancements challenge our concepts of “humanness” (what it means to be “human”). So before starting the discourse on ethical acceptance of human-animal chimera and before reflecting on ethical and legal guidelines for human-animal chimera research,²⁵ some fundamental philosophical-anthropological questions should be clarified.

Among these questions are :

What does “human nature” mean?

What does “animal nature” mean?

How do we define human/animal nature? Which criteria do we use for defining?

What is the reciprocal relation between animal and human nature?

What is common for both of them?

Where are the boundaries between these two natures?

How do we define “species”? Should the biological definition rely on the species definition?²⁶

²⁴ J. Fletcher, *The Ethics of Genetic Control. Ending Reproductive Roulette*. Buffalo: Prometheus Books 1988, pp. 171-173.

²⁵ For policy making and legislation, the attempt to find middle ground between prohibitions and self-regulation of biotechnology is of importance. One of most feasible solutions is to extend the existing liberal democratic compromise with respect to equal protection. The compromise also includes banning the monopolisation of certain biotechnologies. Cf. N. A. Adams, *Creating clones, kids & chimera: liberal democratic compromise at the crossroads*. In: *Issues In Law & Medicine*, 2004, 20(1):3-69.

²⁶ L. M. Glenn, *When pigs fly? Legal and ethical issues in transgenics and the creation of chimeras*. In: *Physiologist*, 2003, 46(5):254. “A scientist could argue that distinguishing traits between species are manifestations of the genetic material of each species. However, the definition of species is a hotly debated and contentious issue among scientists [...] The un-

What is the relation between “human nature” and the biological species *homo sapiens*?

What is the meaning of “human dignity”? Does the human dignity argument justify the prohibition or tolerance of human embryonic chimera?²⁷

What constitutes human identity?

What philosophical notions of “human” are used in legislations?²⁸

Or in summary, what does it mean to be human? What image of human (*Menschenbild*) do we use?

After these questions have been answered, the issue of moral status, moral options and moral guidelines (and subsequently of legal regulation) concerning humanoid chimeras can be addressed. We need to be prepared to ask: “How can we preserve our human rights and dignity despite the fact that our ‘humanness’ may no longer be the exclusive possession of Homo Sapiens?”²⁹

b. Should we cross boundaries?

Chimeras and hybrids challenge our understanding of human being in general. Similarly, they challenge our understanding of “species” and “nature” (human na-

comfortable truth is that species differentiation is not as clear-cut as some would like it to be“ (ibd.).

²⁷ Although the human dignity argument does not necessarily support and justify prohibition of chimera usage. For instance, the transplantation of adult human neural SC into prenatal non-humans offers a possibility for studying human neural cell development without direct use of human embryos. Such experiments, raising significant ethical concerns especially regarding mixing of human and nonhuman tissues and in development of human-nonhuman chimeras. Some authors argue that human-nonhuman chimeras research does not violate human dignity ipso facto if certain ethical guidelines for conducting such research are observed. – Cf. P. Karpowicz, C.B. Cohen, D. van der Kooy, Developing human-nonhuman chimeras in human stem cell research: ethical issues and boundaries. In: Kennedy Institute of Ethics Journal, 2005, 15(2):107-134; M. Greene, K. Schill, S. Takahashi, A. Bateman-House, T. Beauchamp, H. Bok, D. Cheney, J. Coyle, T. Deacon, D. Dennett, P. Donovan, O. Flanagan, S. Goldman, H. Greely, L. Martin, E. Miller, D. Mueller, A. Siegel, D. Solter, J. Gearhart, G. McKhann, R. Faden, Ethics: Moral issues of human-non-human primate neural grafting. In: Science, 2005, 309(5733):385-386; J. Savulescu, Human-animal transgenesis and chimeras might be an expression of our humanity. In: The American Journal of Bioethics, 2003, 3(3):22-25; T. Seyfer, The ethics of chimeras and hybrids: dignity and original solitude. In: Journal of Medical Ethics, 2004, 29(8):1-4.

²⁸ In law, the term “natural” persons is limited to biological entities that are humans at the same time. Nevertheless, the term “human”, being taken for granted, is not defined legislatively. This philosophical-anthropological unclearness concerning “human” (built on the assumption of self-evidence) has serious (not only) legal implications. – Cf. L. M. Glenn, A legal perspective on humanity, personhood and species boundaries. In: The American Journal of Bioethics, 2003, 3(3):27-28; L. M. Glenn, Biotechnology at the margins of personhood: An evolving legal paradigm. In: The Journal of Evolution and Technology, 2003, 13:35–37.

²⁹ L. M. Glenn, When pigs fly? Legal and ethical issues in transgenics and the creation of chimeras. In: Physiologist, 2003, 46(5):254.

ture, animal nature). Is “nature” biologically based on genes, cells, organs or on “species”? What kind of notion of species are we using? What are the boundaries between individual species? Where do they lie? After clarifying these factual biological and scientific questions, we are challenged by fundamental ethical and moral question “Should/can/shall we cross the species boundaries?”³⁰ Concerning the moral relevance of the species boundaries three main positions can be identified. For some people, species boundaries have no moral relevance;³¹ while others view them as having moral relevance;³² the third group, admitting some moral relevance, would argue that interspecies boundaries can be crossed and such experiments may be conducted ethically – though taking for granted moral relevance of boundaries, including interspecific ones.³³

From the statement of moral significance of boundaries it does not necessarily follow that crossing boundaries *ipso facto* interferes with moral rightness. Another question is what are the boundaries? Are we allowed to cross them on the vegetal level between plants of various species?³⁴ Are we allowed to cross them on animal level, creating animal hybrids and chimeras? Should we cross the boundaries separating the plant and animal kingdom? Humans and animals? On genomic, cellular, tissue, organ, embryo/chimera level? Can we discover these interspecific boundaries in a way different from experimental one? How is the biological identity of humans as a species related to personal identity? What does it mean to be “not-fully-human”?³⁵ What are anthropological and philosophical implications of the biological fact that we are genetically almost identical to apes?

c. The art of slowness

An old wisdom says: it is dangerous to stress the similarities between human and animal, more dangerous is to omit differences between human and animal and the worst thing is to be unaware of both. This old wisdom seems to be of high importance in the contemporary debate about human-nonhuman chimeras. The basic rule for solving problems is: not to solve problems in such a way that creates (new) problems even bigger than the original ones.

³⁰ Cf. J. S. Baylis, F. Baylis, Crossing species boundaries. In: The American Journal of Bioethics, 2003, 3(3):1-13.

³¹ See for instance A. W. Siegel, The moral insignificance of crossing species boundaries. In: The American Journal of Bioethics, 2003, 3(3):33-34.

³² As example see R. Streiffer, In defence of the moral relevance of species boundaries. In: The American Journal of Bioethics, 2003, 3(3):37-38.

³³ Cf. P. Karpowicz, C. B. Cohen, D. van der Kooy, It is ethical to transplant human stem cells into nonhuman embryos. In: Nature Medicine, 2000, 10(4):331-335.

³⁴ The idea of transgression is a complex one. – See also P. B. Thompson, Crossing species boundaries is even more controversial than you think. In: The American Journal of Bioethics, 2003, 3(3):14-15.

³⁵ S. Franklin, Drawing the line at not-fully-human: what we already know. In: The American Journal of Bioethics, 2003, 3(3):W25-W27.

As we know from experience, the quickest way is not always the best one. First we should learn the virtue of slowness - which is quite incompatible with the rush biotechnological and biomedical development – and to think deeply before we decide to move forward with human-non-human chimeras research. The prospect of creating or redesigning new human life should be held to an ethical standard of appropriate reflection. Since the whole prospect has not yet been defined sufficiently many related fundamental anthropological questions need clarification. A broad public discussion and ethical reflection is needed prior to deciding whether to start with the project of redesigning human life into novel forms (and to extend embryologic research conducted on non-human animals to humans).³⁶ The whole of society must address the philosophical, ethical, and legal issues of altered organisms. It seems that a thoughtful approach will be appropriate.³⁷

³⁶ Cf. N. J. Jones, W. P. Cheshire, Can artificial techniques supply morally neutral human embryos for research? Creating novel categories of human embryos. In: *Ethics and Medicine*, 2005, 21(1):29-40. Other authors like Robert and Baylis criticise earlier attempts to forbid crossing species boundaries in the creation of novel beings (J. S. Robert, F. Baylis, Crossing species boundaries. In: *The American Journal of Bioethics*, 2003, 3[3]:1-13).

³⁷ Thoughtful approach should be adopted for chimera patent policy as well – despite the pressure on swift and smooth patenting. The keynote “Patent first, ask questions later” is certainly not the best policy. - Cf. M. A. Bagley, Patent first, ask questions later: morality and biotechnology in patent law. In: *William Mary Law Review*, 2003, 45(2): 469-547.

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European and International Research
Scientific, Ethical, Philosophical and Legal Aspects
Taupitz, J.; Weschka, M. (Eds.)
2009, XIX, 1039 p., Softcover
ISBN: 978-3-540-93868-2