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Chimera
The Animal, The Machine, And The Almost Human:

investigating ontological instability of the body

Reflective documentation

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Ana Rajčević

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Abstract

The research “Chimera: the Animal, the Machine, and the Almost Human” explores the ontological instability of human bodies and the mutable nature of our experience. Representing a dynamic convergence of artistic and scientific inquiry, it questions how culture and technology have altered our understanding of being human across different temporal landscapes. Specifically, the investigation delves into the enduring concept of *Chimera*, a creature central to my enquiry. Springing from Greek mythology as a monstrous entity with a triple body – a fusion of goat, lion, and snake – the term ‘Chimera’ has evolved to describe hybrids of various creatures, and experimental biotechnological organisms with distinct genetic material or ‘cell lines’. Embracing the flexibility of the term itself, the Chimera in my artistic practice symbolizes a fusion of entities and practices, born from the amalgamation of machine, animal, and human, as well as the blend of artistic, scientific, and cultural endeavors I have engaged in. It stands as a dynamic, malleable, augmented and continuously cultivated novel being, continually evolving through the practices of technology (medical and scientific) and literature (fictional and academic). The research interweaves stories of scientific advance in robotics, prosthetics, gene splicing, and stem-cell implantations with the imaginative realms of mythology, history, art, and literature. In conjunction with my artistic practice, which creates Chimera entities by altering and extending the body through non-anthropomorphic artifacts or ‘chimeric embodiments’, the study explores diverse scenarios of possibilities, consequences, and experiences of mental and somatic boundaries and mutations. It particularly investigates the role of animal–human imaginings as a catalyst for reconfiguring discourses around technological advancement and as a possible driver for redesigning socio-political entities that can explore and imagine futures. Through a dialog between historical and contemporary practices of hybridity and human augmentation, including my own *Chimera* artworks spanning the last 13 years, this research probes corporeal possibilities and transcendent technological experiences that may have the potential to forge alternative ingenuities, identities, ideologies, and ways of perceiving our world.

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Introduction

Imagine a future of radical transformation. A future of a wide range of hybrid entities and polymorphous diversity. A world where fiction can become tangible and real. Imagine that our somatic and mental experiences take place in multiple new realms, where novel concepts of integrity, kinship and unforeseen relations arise. A future where advanced technologies can devise new ontologies and diverse identities. Where our physical, cognitive and sensory capabilities are reconfigured, forging alternate ingenuities and novel ways of perceiving our world. Imagine a world where human and non-human, organic and inorganic, normal and abnormal, male and female, are finally a viable unity.
That future, for me, is the realm of the invincible Chimera.

This research investigates a multifaceted character, a lead actor in both fiction and contemporary (bio)technological research, called Chimera. It will show how Chimera serves as a versatile vehicle for exploring the realm of the (im)possible Other, and a potent being that can step beyond conventional confines. It draws on historical and contemporary practices of hybridity and human augmentation, as well as my own chimeric artworks conducted over the last 13 years – in my art studio as well as at various science and technology institutes and stem-cell research laboratories. Its focus is therefore on the creation and possibilities of the Chimera hybrid, which I see as the merging and convulsing of human, animal and technology. In particular, this research investigates animal-human imagination as a catalyst for reconfiguring discourses of technological advances and socio-political entities that can explore and imagine futures.

By traversing and fusing the domains of literature, culture, science, and art, I use Chimera to create artworks, or what I term 'chimeric embodiments' and imaginaries that alter and enhance the body through animal-inspired appendages. Positioned at the intersection of art, technology and medical sciences, these creations challenge traditional boundaries within the arts themselves, as well as between artistic practices and the applied and natural sciences. Existing across time and disciplines, these

chimeric artworks know no binaries; they represent a disruption of the conventional order of things, a multifaceted entity fusing human and non-human, biological and artificial, normal and abnormal, the imaginary and the real. This research into the Chimera is therefore an exploration of questions of identity, agency, able-bodiedness, ontology, species boundaries, and cognitive experiences. It reflects on the transformational politics of the human, animal and technological in scientific and biomedical research, asking how the ever-shifting material forms and substances in which human subjects are embodied configure understandings of 'humanity' itself.

The construction of these 'chimeric embodiments' has necessitated a critical multidisciplinary approach that combines experimental art with research in technology, biomedicine, history, materials science, and psychology. This approach is interwoven into five broad and interlinked thematic units that Chimera research will lead you through: the body, its imaginations, technologies, materializations, and their effect on the human experience.

By incorporating both organic and inorganic matter and human and non-human entities, the research aims to uncover the multiple possibilities of human 'plasticity', asking: How does the prosthetic materialization of change, by navigating a tension between research object and aesthetic subject, intervene in discourses of science and art, of 'normal' and 'able(d)' bodies, offering alternative experiences of embodiment itself? Could we transform our bodies with non-anthropomorphic structures that might lead us beyond our human physicality, sensory experience, and cognition, and towards new and unforeseeable ingenuities? And what does it mean to be human as we transform into Chimeras?

This research project looks at how the meaning of the human becomes problematic and unknown when other entities are being designed and cultivated by emerging technologies such as robotics and gene-editing. It involves an examination of the impacts and intersections of both histories of bodily fiction – mythology, art and literature – and 21st-century bodily facts – cybernetics and biotechnologies – on our understanding and the future possibilities (and consequences) of human experience. Situated at the tense border between mind and body, rational and subconscious, human and non-human, it asks you to imagine the new possibilities of somatic and mental experience to come.

However, we should not expect this Chimera research and its embedded artworks to be accountable for answers (although I do hope they will generate some vital questions). They are not here to tell you what's right or wrong, nor to ask when and how, but to ask why and – more importantly – why not? They are a dialog, a discussion, an issuing, a possibility, and a means for wonder in the service of generating new perspectives, ideas, understandings and interpretations of bodies and their embodied identities.

Yet they are not fictions. They are perfectly real. Crafted, molded, manipulated, and dispensed, giving cognitive and emotional action to their intrepid audience.

While I will guide you through the journey from the imaginative realm of the Chimera to its specific possibilities in a relatively linear fashion, with a parallel dialogue between the research and the practice, feel free to explore its chapters and project individually or in any sequence you choose. Much like my own work, this exploration involves a blend of literary and scientific writing styles, creating a synthesis that mirrors the diverse facets of the Chimera itself. As a composite of various parts – multiple realms, entities, disciplines and techniques (including scientific, artistic, political and more) – this Chimera research calls you to wander into uncharted territories and possibilities of both the metaphorical and the existent potential of our bodies, and unforeseeable transformations and relations between human, animal, and technological beings.

On a cautionary note, if this reading elicits in you a strong emotional response, whether it's discomfort, anger, excitement or curiosity, then my research has successfully achieved its intended purpose. However, if it leaves you feeling indifferent, I'd be equally intrigued to find out why.

The Conquest of Love

For 'tis through Earth that Earth we do behold
Through Ether, divine Ether luminous,
Through Water, Water,
through Fire, devouring Fire,
And Love through Love,
and Hate through doleful Hate.

Empedocles (c. 492–432 BCE)

The earliest recorded account of the theory of natural selection comes from the Greek philosopher Empedocles, writing in the 5th century BCE. In his *On Nature and Purifications* series of poems, he expounded a four-stage evolutionary system of living things, conceived from the four primary elements of the universe: earth, air, fire, and water. According to Empedocles, these eternal elements had the ability to create all entities, including all living creatures, through intricate mixtures of diverse combinations and proportions. With the spontaneous generation of anatomical parts, the individual limbs and organs of both humans and animals were initially produced from the very substance of the earth. These separately roaming bodily parts then came together under the power of Love, and were joined by the whims of Chance. Eyes "strayed up" in search of foreheads, and arms "wandered bare, seeking" shoulders, headless bodies and disembodied heads. These were joined in wild and seemingly random combinations: creatures with countless hands and heads, hermaphrodites, and ox-man mixes came into existence (Campbel, n.d).

> "Many creatures with faces and breasts looking in different directions were born; some, offspring of oxen with faces of men, while others, again, arose as offspring of men with the heads of oxen, and creatures in whom the nature of women and men was mingled, furnished with sterile parts"
>
> (Empedocles, in Burnet, 1920, p. 229*)*.

And of all those myriad forms only a few managed to survive, reproduce, and become the species we know today.

Seemingly inspired by comparing the mythological creatures with those the author saw around him, Empedocles' work offers a unique conception of the chemistry and scientific thinking of his time (Sax, 2013; Campbel, n.d.; Burnett, 1920).

This mechanistic theory, which Campbel explains as a form of "botanical analogy: original spontaneous generation of life from the earth", foreshadows Darwin's idea of natural selection. In contrast to Darwin's theory, Empedocles' vision doesn't suggest a gradual evolution from one species to another. Instead, it envisions an eternal process of mixing and unmixing, of random hybrid combinations produced through the interplay of eternal powers, in which Chance, rather than Gods, played a leading role (Campbel, n.d., *Biology,* para. 4.a).

Faceless (medical-bioresin, rubber, wax, 2013)

FACELESS

Faceless is a diverse and versatile body adorned with a large animal-appendage. To some, it is 'degeneration,' too large, no eyes, thus disadvantageous and counterproductive. To others, it is beautiful, powerful, and liberating, thus rather productive and (super) advantageous. It is a complex interaction and opposing transformation of intricate and dual nature and (un)necessary deviations of evolutionary processes. Both beautiful and grotesque, human and animal, *Faceless* is a mesmerizing hybrid, challenging the conventional boundaries of form and function.

The Wondrous Other

In nova fert animus mutatas dicere formas corpora.

My aim is to sing of the ways bodies change,
ceaselessly transforming into other forms.

Ovid, Metamorphosis (c. 8 CE)

> "Mais quel agent pourroit estre assez fort en la nature pour conjoindre deux choses si différentes qu'un corps d'homme et de beste, et faire en sorte que deux estres si dissemblables en leur matiere, si inegaux en leur vie, et si contraires en leurs ames, se peussent unir et s'attacher ensemble si éstroictement, et se mouvoir si conjoinctement sans aucun contredict de part ny d'autre ? Et quels inconveniens ridicules ne s'ensuivroient point de cette conjonction?"
>
> "But what agent could be strong enough in nature to bring together two things as different as the bodies of man and beast, and make two beings so dissimilar in their matter, so unequal in their life, and so contrary in their souls, unite and attach themselves together so stoically, and move so conjointly without any contradiction on either side? And what ridiculous inconveniences would not follow from this conjunction?"
>
> (Hédelin, *Des Satyres*, pp. 98-99; translated by the author)

Transformations in mind and body are one of the most contentious and resonant themes in science, literature, and art. The ancient desire to transcend our human bodies, and transform into "something other than the animals we are" (O'Connell, 2018, p. 1) echoes the problematic nature of understanding what it means to be

human. Monsters, deities, cyborgs, chimeras: hybrids of all kinds have haunted literature and art, fiction and fantasy, myth, science, and theory, from prehistory to the present day. These beings, whether fictional or scientific, imaginary or real, outstanding and extraordinary, serve as focal points and representations of deviations from the norm. They are disturbing or frightening, fantastic or alluring, or simply deemed inadequate. Belonging to a realm distinct from our own, yet at the same time allied with it, they are the creatures of boundaries. As Jeffrey Jerome Cohen writes in his *Monster Theory: Reading Culture*, "these extraordinary beings provide a labyrinthine frame for the abnormal, impure, uncanny, monstrous, but fascinating and desirable Other" (Cohen, 1996, p. 20). In essence, these creatures exist as captivating embodiments of the extraordinary, serving as a reflection and exploration of the unknown and alluring aspects of the human experience.

Mythologies worldwide are full of tales of intimate kinships forged between humans and animals, and have featured speculations about the possibility of fusing animals and humans into a single entity (Sax, 2013). This cross-bred image of beings that are part-human and part-animal is a recurring motif found in the legends and stories of nearly every culture. One of the oldest known works of literature, the *Epic of Gilgamesh*, is replete with hybridity as a central theme. Inscribed on clay tablets in the Sumerian language around 2000 BCE, it tells the story of a battle between Gilgamesh (part mortal, part god) and Enkidu (a man–animal hybrid) against a monster named Humbaba, described as having a lion's head and paws but a scaly body (Sanders, 1972). The Sphinx at Giza, a mythical being with a woman's head and the body of a lion, is at least 4,500 years old. In India, the Hindu deity Ganesh is a hybrid of an elephant head and a child-like human body, while Vishnu manifests as a fierce lion–man monster named Narasimha. The Greeks' myths of the Centaur (human/horse), Satyr (human/goat), Onocentaur (human/donkey), Minotaur (human/bull) or Egyptian deities such as Anubis (human/jackal), Horus (human/falcon) and Thoth (human/ibis) are further examples.

Folklore traditions are also full of animal transformations, like the Celtic tales of selkies, where humans shape-shift into seals, or the shamanistic transformation of spirit animals such as the fantastic foxes of Asian lore.

One of the most famous hybrids in Greek mythology is Chimera (Greek: Χίμαιρα), the daughter of the deities understood as the father and the mother of all monsters: a half woman and half snake (Echidna), and a giant with a hundred dragons' heads, named Typhon. Born with a triple animal body, whose "many forms grew together in one" (Plato, *The Republic*, Book IX, p. 588), she breathed fire from three heads and was a thing of immortal nature, "not of men", lion-fronted, "in the hinder a serpent,

and in the midst a goat" (Homer, *Iliad*, Book 6, line 180). Often depicted as having a snake-headed tail, it actually referred to a dragon's supposed physiology rather than to that of a serpent (Powell, 2004).

The Greek word 'chimera' originally meant 'she-goat', and was adopted from the Sanskrit 'kimeros', derived from 'shramana', signifying 'the enlightened' (Spyrakou & Stavridi, 2022). Its unbounded body symbolizes uncanny, sublime experiences, and terrifying or awe-inspiring objects. It is contradictory and incongruent, ambiguous and pervasive, oppositional and conflicted, representing the "extremities of transgression and the limits of the order of things" (Milburn, 2003, p. 603). This complex, paradoxical being became a symbol for all that was imaginary, grotesque, wondrous, and out of reach. It served as a multifaceted bridge between the human, the non-human, the otherworldly, and the divine. Part familiar, part strange, part us, part other, Chimera is the endless variety of being, a creature of multiple and contradictory identities.

A Medusa, a Centaur, a Minotaur, a Pegasus, these juxtaposed beings all stand as examples of an interspecies legendary Chimera, numerous prodigious cross-breeds whose corporeal formations endow them with unnatural powers. Employed across various cultural and religious contexts for millennia, including Christian, Egyptian, Greek, Indian, and Nordic mythology, one could assert that the very essence of all mythologies is grounded in the idea of the Chimera (Tauptiuz & Wescha, 2009; Spyrakou & Stavridi, 2022). As a potent character in contemporary thought, Chimera plays a fundamental role in what Marina Warner calls "the fascination with fantastic" (Warner, 2007, p. 243).

The enduring power of this heterogeneous archetype is evident through its persistence in stories within contemporary popular culture. From creatures like werewolves and vampires to human-animal hybrids such as *Ape Man*, or *Spider-Man* (who, after being bitten by a radioactive spider, can climb walls and hang on ceilings) to more recent stories of robots and human–machine cyborgs, the endless variety of fantastic creatures are symbolic expressions of our aspirations, desires, fears, and emotions. They have assumed a central position in the cultural imagination, disrupting an "apprehensible world" in order to open space for possible alternatives (Warner, 1994, p. xvi).

Poet and cultural historian Robert Bringhurst, who has translated substantial works from Greek and Arabic classics, characterizes myths and legends as "doorways between realms" helping human beings to digest "their sense of the world" (Bringhurst, 2011, p. 408; p. 63). These psychological archetypes are "stories of our search through the ages for truth, for meaning, for significance" (Campbell et al.,

2012, p. 4). As literary and cultural vehicles for understanding the world, myths, and its hybrid creatures, they are thus "the entry-points to a deeper understanding of a culture's way of thinking" (Davis, 2016, p. 14).

Psychologists and scholars of comparative mythology have long questioned our enduring fascination with hybrid creatures, in particular human and animal hybrids. Since the philosophers of Plato's Academy asserted that 'human' can be defined by its distinction from the 'animal', the barriers between the species have been rigorously applied. From the ancients (Aristotle, Plato, Homer) to 20th-century thinkers (Harraway, Agamben, Braidotti), the fault-lines that separate humans and animals have been predominantly drawn by the discourse of "western" philosophical thought. The dual animal–human identity often served as a metaphor for dichotomies like evil/good, instinct/reason, order/disorder, self/other, and human/non-human, revealing humankind's anxiety about its own existence. As creatures occupying the margins of hierarchical binaries, the hybrids, as examples of an impossible 'Other', thus "serve to delineate the fault-lines of exemplary and normative humanity" (Graham, 2002, p. 19). Since they do not participate in the classificatory "order of things", hybrids are symbols of alienation and our own otherness. They are the potent characters whose internal and external incoherence "threatens to smash distinctions" (Cohen, 1996, p. 6). Hybrids thus reflect our anxiety concerning concepts of humanity, introducing the potential for dualities to be disrupted.

From Gilgamesh to Marvel Comics, narratives about the transformation of species have served as a vehicle for discussing our fundamental ideas about life, death, time, and identity. They excite our imaginations, negotiating what we might have been, what we might become, or what we fear turning into or aspire to be. What lies at the heart of these myths and stories is thus our intrinsic fear of, and desire for, change and novelty.[1] If we can change, if we can transform into such foreign hybrid beings, would this alteration deprive us of our identity, and even of our sense of humanity?

As Boria Sax argues in her book *Imaginary Animals*, hybrids present our "amorphous fears as 'monsters' while embodying our hopes as 'wonders'" and yet, she

1 Personality neuroscience research has shown that a rush of dopamine promotes exploration and is associated with novelty-seeking behavior. It is believed that this is an evolutionary trait that motivated early humans to explore and learn about new environments as well as promoting a tendency towards innovation and creativity. On the other hand, dopamine is also responsible for 'uncertainty-related anxiety', driving defensive aversion-oriented responses such as fear and panic. This implies that anything which is novel, and thus uncertain or unknown, is a specific type of stimulus that can be perceived as both threatening and promising at the same time (DeYoung, 2013).

concludes, “their greatest service may be to continually challenge our imagination, directing us beyond the limitations of our conventional beliefs and expectations” (Sax, 2013, p. x)

Taurus (polyurethane, rubber, wax, 2015-2016)

TAURUS

Imagine you stumble upon a being born from the union of man and bull. Its upper form is adorned with majestic and formidable horns, heavier and larger than its own frame should bear. Yet, the lower part mirrors your own, akin to your biological form, matching your own strength, fortitude and essence. Suppose you end up in a territorial or fearful dispute, entangled in a conflict in which you cannot prevail, a battle of insuperable odds. You find yourself unable to counter the dominance of its formidable upper-body advantage – too robust to contest, too substantial to defy. Survival thus compelling you to strike the creature, you deliver the fatal blow. Would you have then killed a fellow human, or a vigorous and splendid animal creature?

The Man Half Bull – The Bull Half Man

All that you touch
You Change.
All that you Change
Changes you.
The only lasting truth
is Change.

Octavia Butler
(1993, from Parable of the Sower, set in 2024)

Two thousand years ago, in his *Metamorphoses*, the Roman poet Ovid depicted both nature and humanity as a newly born, chaotic, and ever-changing whirlpool, where all matter, animate and inanimate, was caught up in a cycle of physical and metaphorical change. All beings "transformed into shapes of a different kind" (Ovid, c. 8 CE, cited in Innes, 1955, p. 29): from human to animal, human to a deer, bear or spider, human to inanimate objects, whereby men and women become trees, stones, and statues; to transformations of gender, color, materiality. "Like pliant wax which, stamped with new designs, does not remain as it was, or keep the same shape, [...] but incorporates itself in different forms. [...] Everything is in a state of flux, and comes into being as a transient appearance" (Ovid, ibid., p. 339). The title of his collection of poems, referring to transformations, to a changing of shape, is a motif running through his verse. From the fights of Centaurs (human/horse hybrids) to the story of 'the man half bull, the bull half man' ("semibovemque virum, semivirumque bovem"), to the polymorphic Salmacis[2] creature and snake-like Cadmus, Ovid transforms his characters into a

2 Salmacis was a naiad (a nymph) dwelling in a spring in Caria, Anatolia. She fused with her unrequited love, the god Hermaphroditus, because of her wish to be united with him forever, creating the first hermaphrodite to feature in a myth. "... their bodies were united and from being two persons they became one. As when a gardener grafts a branch onto a tree, and sees the two unite as they grow, and come to maturity together, so when their limbs met in that clinging embrace the nymph and the boy were no longer two, but a single form, possessed of a dual nature, which could not be called male or female, but seemed to be at once both and neither." (Ovid, ibid., p. 104, translated by Mary Innes).

wide range of hybrid entities. Presenting the "quasi-divine and ethically impeccable human beings, to bestial and blasphemous" possibilities (Gildenhard & Zissos, 2016, p. 26), *Metamorphosis* is a history of the world told through corporeal transformation.

> "*Dixit, et ut serpens in longam tenditur alvum durataeque cuti squamas increscere sentit nigraque caeruleis variari corpora guttis. In pectusque cadit pronus. Commissaque in unum paulatim tereti tenuantur acumine crura.*"
>
> "As he spoke he was a snake that stretched along the ground. Over his coarsened skin he felt scales form and bluish markings spot his blackened body. Prone upon his breast he fell. His legs were joined, and gradually, they tapered to a long smooth pointed tail."
>
> Ovid, Metamorphoses (c. 8 CE)

Ovid's exploration of polymorphous diversity and the celebration of complete change[3] expresses the boundless possibilities of the human body and the mutability of human experience. In this multifaceted and unconventional vision of the universe, Ovid achieved a complete breakdown of conventional forms, putting together a 'pastiche of genres', a hybrid work of prose filled with possible beings, challenging our perspectives to this day. Dealing with various relations between humans, animals, materials, and objects (through mediation, metamorphosis, and merging), these hybrids are a testing grounds for exploring possible ways of being in the world. *Metamorphoses* thus became one of the most fundamental sources for discussions and interpretations of various human/non-human transformations.[4]

As markers of the boundaries of our understanding, hybrids (whether animate like human–animal or inanimate like human–object/machine) have since been renegotiated in theory as well as in art and popular culture. Cultural historian Surekha Davies describes hybrids as "that which appears strange to our eyes" (Davies, 2016, p.14).

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3 "Omnia mutantur nos et mutamur in illis": All things change, and we change with them (translated by Mary Innes).

4 Etymologically, trans-formation literally means 'beyond form', or 'changing the form of', while metamorphosis (from the Greek 'transfigured') describes this conversion process. In biology, transformation can refer to an evolutionary process, a change of structure of an organism as it passes through stages of metamorphosis from one phase of development to the next, like the changes of insect metamorphosis from larval to adult stage, or the genetic alteration of an organism in the science lab.

They are transgressive beings that provoke a reaction, threatening our common systems of knowledge with their propensity for cultural and scientific shifts and violations. Associated with otherness and exteriority, hybrids and their analogous equivalents, both corporal and incorporeal, 'natural' and 'unnatural', are foremost cognitively 'threatening', challenging the very foundations of a culture's way of thinking (Carroll, 1990, p. 34).

Ovid's vision of contradictory and chaotic hybrid combinations challenges linear and binary perspectives, pertaining to the evolution of dualities that mutually constitute each other. In this framework, what may initially be perceived as 'degenerations' can lead unexpectedly to *re*generation. Like the story of Arachne, where her 'deviation' into a spider grants her the ability to weave intricate webs, so that what might seem to be a disadvantage transforms into an extraordinary and unforeseen advantage.

Animal: The Other Side of Evolution (bio-epoxy, rubber, wax, 2012)

ANIMAL

Animals have evolved diverse and versatile bodies, with appendages enabling many kinds of use across many tasks, from locomotion (maneuverability and stability) to feeding, protection, reproduction, sensing and general survival strategies. However, some of these appendages are also disadvantageous and counterproductive, such as the babirusa's tusks, overly large horns of bovine animals such as deer[5] or sheep,[6] vestigial limbs like those of flightless birds, or the 'eyes' of blind fishes[7] and arthropods.

But these 'degenerations' can unexpectedly result in new sensory abilities and biomechanical functions, turning disadvantages into (super-)advantages and vice versa. These complex interactions and opposing transformations paint a rich backdrop for the intricate and interconnected nature of evolutionary processes.

The babirusa (Babyrousa babyrussa), for example, is an enigmatic and peculiar creature, originating from the Indonesian island of Sulawesi. With their hybrid appearance, part pig and part deer (hence 'babi' for pig and 'rusa' for deer), they have antler-like tusks and barrel-shaped porcine bodies. Their curving tusk-like canines, exclusive to males, grow

5 Antlers that grow extremely large are often considered as 'display' organs, because they have an intimidating effect on potential competitors, which can reduce the need for overt fighting. However, it has been demonstrated that fleeing from predators is a more effective protection strategy than engaging in combat. Therefore, large antlers, which require a substantial amount of energy to support and withdraw significant bone material from the skeleton, can place these visually striking animals at a disadvantage compared to antlerless male deer (Geist, 1966).

6 In wild Soay sheep (native to the Western Isles of Scotland), large horns confer an advantage in the rams' competition for mates, which in turn leads to higher reproductive success. However, males with smaller horns have greater survival rates, resulting in a longer life-span and therefore consequently in a net effect of over-dominance, known as heterozygote advantage, for fitness (for more information, see the study by Johnston et al., 2013).

7 Researchers have found that the loss of vision in cavefish significantly reduced energy expenditure on brain neural tissue during adaptation to subterranean rivers, where vision was irrelevant in total darkness. With vision regression, they became more reliant on smell and taste, resulting in an increased sense of taste. Additionally, they developed heightened sensitivity to mechanical pressure, enhancing their ability to detect water movements. This evolutionary loss therefore conferred a distinct advantage (see for example the study by Yamamoto at al., 2009).

throughout their lives, piercing the skin of their snouts, curling upwards and then back towards the babirusa's eyes and forehead.[8] While these curving teeth offer advantages, believed to be for face protection and sexual dominance, they also present a huge disadvantage, as the teeth can grow to such lengths that they penetrate the animal's skull, ultimately leading to its death.

Inspired by the mysterious Babirusa teeth, I brought to life a tusk-like appendage, marking the birth of my first Chimera creature in 2012. Engaged in an intricate dance between mutation and evolution, navigating the realms of advantage and disadvantage, I envisioned 'hybrid-humans' adorned with functionless augmentative animal limbs. This exploration delves into how we might coexist with and adapt to alternative 'chimeric embodiments' stripped of practical function. Simultaneously, it probes the question: How could we change our biological body representation and expression through animal-like body augmentation? This uncharted realm, the "other side of evolution," unfurls a space for redefining models of embodiment and a contemporary cross-image of human and animal. Beyond the confines of past and future, it hints at an atemporal, boundless creature embodying the intricate interplay between advantages, disadvantages, and the unforeseen consequences of the evolutionary journey.

8 This is an extremely rare feature in mammals. For more about the babirusa, see Macdonald (1993).

When Traditional Bodies Fall

Once you have tasted flight,
you will forever walk the earth with your eyes turned skyward,
for there you have been,
and there you will always long to return.

Anonymous (often attributed to Leonardo da Vinci, 1452–1519)

One of the most famous myths of classical antiquity, originating some time between 2600 and 1450 BCE, is the tale of Daedalus and Icarus. Known for his self-moving statues and automata, Daedalus, an architect, innovator and craftsman, constructed flying devices for himself and his son Icarus in order to escape prison. By studying and mimicking the movement of birds, he fashioned two pairs of artificial wings out of feathers, threads, wood, and wax, layering feathers carefully according to their size and shape. Flapping the wings fixed to their backs and arms, "… just like a bird who has brought her tender fledglings out of their nest in the treetops" (Ovid, cited in Innes, 1955, p. 185), Daedalus launched himself and his son into the air, thus defying the laws of nature. Even though Icarus did not survive the experiment (due to his hubris in flying too close to the Sun), Daedalus successfully flew across the Mediterranean to Sicily, devising a myriad marvels for the rest of his life.

The Daedalus myth presents the earliest recorded idea of an external bodily appendage, as well as the first human-powered wearable device. It also introduces the pioneering imaginary of the fusion of human, animal, and technology (technē), akin to what Donna Haraway (1991) later referred to as "machines (automatons) and organisms", now commonly known as the 'cyborg' or 'chimera'. Although made from natural components, these wings were a fabrication, something artificially fashioned, thus invading a liminal space between agent and tool, born and made, real and fictional. In their embodied creation lies the timeless desire to transcend human limitations beyond the natural limits. In contrast to the myths of hybrids that merge

human and animal, these artificial wings lack symbiosis; they are not symbiotically related to their wielders and do not integrate into the human body to grow within its confines. Rather, they stand as externally attached, human-made appendages.

Ever since the myth of Daedalus was first told, countless similar legends have emerged, imagining the possibility of augmenting human powers by imitating animal functions. Such is the tale of a master craftsman and blacksmith, Wayland the Smith. After being hamstrung by the king, he crafted himself a set of wings, which enabled him not only to move, but also afforded him the marvels of flight. Similarly, Eilmer of Malmesbury, the famous flying monk from the 11th century, who flung himself off a castle with mechanical wings fixed to his hands and feet. Despite breaking his legs, he attributed the fall to the want of a bird-like tail that he forgot in his design. Or King Bladud, described as the flying King of Britain, who, around 850 BCE, tried another similar feat. The monarch donned wings and ascended to the top of the temple of Apollo, soaring high only to plummet to his death (Laufer, 1928). These endeavors reflect not only a wish to conquer the skies, but also a deep-seated desire to understand and harness the mysteries of the living world.

Recounted by storytellers and illustrated by artists over the ages, Daedalus' tale gave 'wings to dreams' (Mayor, 2017) of technē-powered individuals and human-flight desires, devising fabulous inventions that came to haunt humankind for centuries. These intriguing mythical tales envisioned how craft and artisanship could be used to upgrade our inherent abilities while simultaneously engineering 'hyper'-human possibilities. They are the early tales of body augmentation, reflecting humanity's enduring aspirations to surpass the limits of human boundaries and enhance our capabilities through technological means.

The merging of the natural with the artificial is not a phenomenon limited to modern times, as the ancient legend of Daedalus and Icarus illustrates. This cyborgian relationship between humans and machines is demonstrated through the stories of numerous mythological characters who epitomize possibilities of using technology, ingenuity and craft to enhance nature and engineer hyper-human abilities. Other such examples, situated within a history of ancient technology, are the animated body artifacts built by the god Hephaestus. Known as the god of invention and technology, and the only physically impaired Olympian deity, he has often been portrayed as the creator of 'assistive technologies', such as the staff, stick, crane, and crutch. Yet he is usually better known as the inventor of far superior inventions, such as Hermes' winged hat (πέτασος) and his winged sandals (πτερόεντα πέδιλα). Acting as artificially created birds, they carried Hermes 'wingèd feet… through air to course', as swiftly as genuine birds would have (Anon., *Orphic Hymn 28*). He himself owned winged sandals and a winged chariot, conferring movement and speed on

his impaired feet. Hephaestus and Hermes can thus also be seen as another early example of the surprisingly ancient idea of the cyborg – beings with human-made substitutes featuring other beings' body parts.

Conceived by a society traditionally deemed technologically not advanced, these 'bio-technē' creatures captivated a culture that thrived millennia before robots (Mayer, 2008). These early notions of human augmentation designed to overcome bodily limitations – sometimes known as human enhancement technologies – are as timeless as the awe they evoke. They are part of a "culture caught in the process of transformation", holding multiple fears and aspirations on its surface and at its core. "From bestial monstrosities, to unlikely montages of body and machine parts", as Jennifer González observes, "imaginary representations of the cyborg take over when traditional bodies fail" (González, 1995, p. 58; p. 61). In other words, a cyborg body appears in myth as a novel, complex, and fertile lived experience. It is a manifestation of our early fascination for creating forms of artificial human life by simulating nature. Historically recurring together with the image of a hybrid, a cyborg presents a living animation of a hybrid being. It introduced a shift in the mythological imagination, where artisans and inventors now became notable, even mythic, figures. This new hybrid being thus collapsed the boundary between animal and human, while simultaneously chipping away at the boundaries between the human and the technological.

Second Surface (polyamide, bioresin, nylon, 2013-2014)

SECOND SURFACE

Nature's evolutionary processes have given rise to extraordinary and diverse creatures that ingeniously tackle challenges through an instinctive experimentation that is nevertheless based on principles of physics, mechanics, material science, sensing and morphology – now recognized as science, design and engineering. Structures such as hairs, spikes, thorns, claws and quills, for example, are all wonders found in the animal world. Used for camouflage, protection, insulation and as sensory organs, each of these intricate manifestations of the exoskeleton varies in shape, size, length and number, weaving a wondrous artistry of purpose, play, beauty and adaptation. Known by biologists as integumentary systems,[9] deriving from the skin and other tissues – both rigid and elastic, active and passive – they are the 'super-armors' crafted like a masterpiece by evolution's hand.

Thirteen years ago, I started exploring the realms of the animal in order to create new models of embodiment. I began the creation of 'hybrid humans' or *Chimera* creatures with augmentative chimeric limbs. Drawing inspiration and adapting ideas from the animal world, I delved into the intricacies of various creatures by studying, imitating and reconfiguring their form and function, with the ultimate goal of uncovering and blurring analogies in the realms of engineering, biology, art and psychology. By testing out the boundaries of human plasticity, I was exploring how we might adapt – mentally and physically – to having additional appendages and structures added to our bodies. I started studying animal morphology, locomotion, sensing, actuation, and mechanics, as a means to design novel augmentative capabilities and experiences, endowing human subjects with non-inherent physiques and abilities.

In 2013, for example, with a team of engineers and mathematicians, I explored the integumentary system of animals, using computational methods for 3D printing, creating skin grafts and body appendages with CAD (computer-aided design) structures as small as 16 μm (0.016mm).[10]

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9 For more about integumentary systems, see Kathryn M. Everson's (2015) *Spines and Quills* at https://animaldiversity.orgcollections/spinesquills/

10 Industrial high-end 3D selective laser sintering (SLS) printers can now reach extremely small build-layer thicknesses and resolutions; however 16-μm is still considered extremely rare. Typical layer thickness is mostly around 100 μm (250 dpi)

Integrating knowledge from a diverse array of fields, I blended engineering, computational physics, design-based computing, art, and biology, and together with a team of experts developed one of the first 3D-printed hair- and spike-like surfaces, at the time deemed[11] a "laser sintered miracle". We modeled 800 incredibly fine, artificially designed quill-like appendages of varying micro lengths and thicknesses and contrasting angles to its surfaces, onto a life-sized body-exoskeleton design. By interpreting these biological structures, we pushed the boundaries of possibility in fabricated materials at the time, inspiring further possibilities of even more advanced 'chimeric augmentations'.

although it is still advised not to go under 200 μm.
For a detailed comparative study between 2010 and 2020, see *The Use of 3D Printers in Orthodontics* by Ergül et al. (2023).

11 Duann Scott is a computational design and additive manufacturing specialist at Shapeways, a 3D manufacturing research center and company, as well as a 3D technology specialist and teacher at MIT's Media Lab.

Immortal and Ageless for All Time

χρύσειοι δ' ἐκάτερθε καὶ ἀργύρεοι κύνες ἦσαν, οὓς Ἥφαιστος ἔτευξεν ἰδυίῃσι πραπίδεσσι δῶμα φυλασσέμεναι μεγαλήτορος Ἀλκινόοιο, ἀθανάτους ὄντας καὶ ἀγήρως ἤματα πάντα

On each side there were gold and silver hounds, immortal and ageless for all time, which Hephaestus had crafted with intelligent minds to guard the house of great-hearted Alcinous.

Homer, Odyssey, 7.91-94

Transcending one's own corporeality through the study and imitation of nature, has not only entertained mythology, fiction, literature and art, but also science. The dream of enhancing the human body with artificial improvements to overcome its limitations and increase one's natural strength, expand one's sensory apparatus and enhance one's abilities has been a recurring aspiration, in ancient times and now.

More than 2,500 years ago a marvelous set of ideas and imaginings arose in mythology, envisioning ways of imitating, augmenting, and surpassing natural life, through using 'biotechnē', or "life through craft" (Mayer, 2018, p. 1). Many ancient mythologies have featured artificial people, moving machines, and mechanical hybrids, especially those resembling humans and animals. While some hybrids were 'born' or 'created' as composites of various beings (as shown in previous chapters), -others were 'made' or 'crafted', marking the earliest inklings of the collapse of the distinction between the animate and inanimate worlds, between nature and artifacts.

The word 'automaton' comes from the Greek αύτόματος ('automatos'), meaning 'self-acting' ('autos' 'self' + 'matos' 'thinking', 'animated', 'willing'). It is a term applied to machines that imitate the actions of living creatures, used historically as the means for studying scientific and mechanical systems. Well before technological advances enabled the creation of self-operating devices, the idea of making automata and their relationship to artificial intelligence (to use an anachronistic term) had already been explored in primeval myths, as discussed in the previous chapter, underscoring our enduring fascination with the creation of artificial beings. One of the very earliest

Greek poets whose work survives, Hesiod, around 700 BCE, mentioned the mechanical servants of Hephaestus – or the bronze automaton Talos created to protect the island of Crete by throwing rocks at ships that sailed too close to its shore – and these offer one of the earliest conceptions of a human-like 'intelligent' machine. They also mark the birth of the intersection between ideas relating to the mythical and the mechanical in later centuries.

This goal of simulating life and its processes by replicating the form and anatomy of living creatures can be viewed as representing the origins of modern robotics, and its prevalence as an idea is evident in the appearance of many ancient machines that feature self-animation as a property. Beginning with the inventor and mathematician Ctesibius (285–222 BCE), engineers from Alexandria documented numerous texts that described functional automatons driven by hydraulics (pumps, siphons), pneumatics (compressed air) and steam power (Mayer, 2018; Filson, 2018). Descriptions of these devices that run 'by themselves' often involve self-moving artifacts resembling humans or animals, and were built with the same materials and methods that artisans used for constructing tools and statues. A crucial part of the history of technology, these impressive examples of automata, originally created for entertainment and ritual, led to the development of more advanced skills and technologies.

Equally intriguing were the automated replicas of certain functions and behaviors of animals, including birds, lions, snakes, horses, or hounds, which channeled important scientific discoveries. The mechanical pigeon, postulated by the mathematician Archytas of Tarentum in the 4th century BCE, represents one of the first efforts at understanding the methods of flight, while the eagle–dolphin hybrid device known as the 'hippaphesis' which opened the starting gates at the Olympic hippodrome (or racecourse – 'hippo' 'horse' + 'aphesis' 'gate'), started the first mechanism in Olympia, Greece (Bur, 2016). The first artifacts to reproduce the sounds of living beings are the singing birds of Philon, Heron, and Ctesibius – the latter sometimes known as the father of pneumatics. Driven by compressed air or steam, they are examples of the first hydraulic and pipe organs ever invented (Bedini, 1964) and are the ancestors of the church organs still in use today. Even earlier, Chinese folklore tells of the legendary carpenter Lu Ban, who created a (presumably wind-)powered, flying wooden bird that could stay in the air for three days, which has been suggested as a precursor to the modern kite (Du Shiran, 1992).

By enabling movement in non-living objects, these mechanical beings led to the creation of ingenious and spectacular technologies. These creations demonstrate how the force of imagination and exploration can inspire people to try and recreate nature's marvels, while consequently unveiling new scientific and technological

discoveries. Automata therefore represent the earliest expressions of the timeless impulse to create artificial life – a hybrid of the living and the non-living, of the natural and the artificial – that blurred the boundaries between human and machine.

If hybrid imagination of the 'other' has led to unforeseen empirical and scientific discoveries and novel ways of perceiving the world, then how can we understand the relationships between the apparently 'cultural' practices of myth-making technē, the arguably more utilitarian procedures of technological transformation, and the personal processes of becoming?

Amygdala: MK2 (wax, aluminum, FPGA computer board, servo motors, 2017)

AMYGDALA MK2

Amygdala is the robotic appendage that augments its own body by performing one of the earliest forms of body augmentation[12] and modification known as 'scarification', or skin-cutting.[13] During a month-long exhibition, Amygdala carefully cuts and sculpts its own skin, bearing unique and specific scars caused through the intricate operations determined by its algorithm. Resembling the focused attention manifested in

12 Body modification has a rich anthropological history, with diverse practices including modifying the body through cutting, burning, piercing, implanting, painting, adorning and other means. It has been employed for various purposes all the way back to prehistory. These rituals and traditions are deeply ingrained in cultural beliefs, symbolizing identity, and often marking a passage towards new life stages.

13 This is the process whereby one cuts permanent artistic designs, often with symbolic meaning, into the skin. The procedure may involve repeatedly using a hook or sharp blade on the selected area of the skin to create a specific design. Resulting in specifically designed scar tissue, such acts furnished their practitioners with permanent identity markers. The more general term is skin-cutting, which can encompass surgical procedures as well as instances of self-harm.

body-modification rituals, Amygdala's cuts involve symbolic actions that must be remembered and rehearsed repeatedly with surgical precision, in order to be executed precisely, over an elaborate hour-long sequence. A stand-alone installation artwork, this chimeric appendage tries to 'learn' the human ritual as best as it can, representing a tangible embodiment of the nexus between cultural practices, technological transformation, and the ever-unfinished processes of becoming.

Shocked With the New

That discourse one might call
the poetry of transgression is also knowledge.
He who transgresses not only breaks a rule.
He goes somewhere that the others are not;
and he knows something the others don't know.

Georges Bataille (1897–1962)

In what used to be called "western" societies, there is a strong belief that technology should primarily be used only for practical, labor-saving ends. "The greatest good for the greatest number" (Wilson, 1905, adapting a phrase from the 18th-century utilitarian philosopher Jeremy Bentham) prioritizes practical benefits and efficiency over the broader experience of cultural, artistic or philosophical concerns. This starkly utilitarian view of technologies and its histories, which Serafina Cuomo (2007) in her *Technology and Culture in Greek and Roman Antiquity* terms the 'technical blockade' mentality, arises from an institutionalized division between technology, nature and culture.

It favors a reductionist and purportedly 'objective' view of technologies as tools for advancing practice, neglecting their role in directing and reshaping lived experience,[14] whether sensory, emotional, aesthetic or some combination of these.

Instead of favoring technological progress as the only valuable kind of prosperity, we should look at its power to produce unseen and unforeseeable transformations and possibilities that can produce new ontologies and novel ways of thinking.

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14 In *Technology as Experience*, John McCarthy and Peter Wright characterize 'felt experience' as a measure of the fullness of technology's potential to be more than merely functional. Felt experience refers to emotional (like bodily arousal), evaluative (sensual and affective, such as positive or negative feelings) and intuitive (the sensation of gaining deeper understanding or meaning) experiences. For more about felt experience in general, see William Downes' article *The language of felt experience: emotional, evaluative and intuitive* (2000).

Perhaps, therefore, we should start thinking about what ought to be viewed as the more important technological 'good'. The alternatively felt experience? Or merely quantifiable economic utility?

The word 'technology' is a compound of two Greek words: 'technē', which means the art and skill associated with craftsmanship, and 'logos' or 'word'. The concept of 'technologia' (in Latin) was introduced by Christian Wolff in 1728, who defined it as "the science of the arts and works of art" or "the science of the things which man [*sic*] produces by using the organs of the body, especially the hands" (Frison, 2019, p. 148). In the latter half of the 17th century, Western ideas about the nature of matter (ontology) underwent a profound change, shaped by the thinking of Galileo, Descartes, Newton, and their followers. The term 'technology' thus adapted itself to the radical transformation in European cosmological thought, specifically theories ushered in by Copernicus, Kepler and Descartes (see Mitcham, 1979). The latter, like Newton, saw the universe as a machine that, by means of a rational understanding of its functioning, "could be harnessed to serve human interest and purpose" (Ingold, 1997, p. 131). Together with his ideas about the dualist distinction between mind and body, as well as between humans and non-human creatures, Descartes' ideas led to a paradigm shift in terms of how we think about the relationships between technology, culture, and nature. Technology has since been viewed as a practice-oriented field, rooted in purpose and planning that is "merely technical, in other words mechanical" (ibid., p. 131). Epitomizing the ultimate supremacy of human reason, technology began to affect how later scholars interpreted the phenomena of ancient artifacts and automata.

One of the leading advocates of this 'hyper-serious' approach to technologies is Örjan Wikander (cited in Bur, 2016). In his essay "Gadgets and Scientific Instruments", featured in *The Oxford Handbook of Engineering and Technology* (2008), he rejected spectacle and exploration in terms of how automata function, describing them "as object lessons in mechanical and pneumatic principles, rather than as tricks intended to inspire wonder" (Wikander, 2008, p. 785; Bur, 2016, p. 17). Yet the desire to comprehend the profound mechanisms of life through mechanics, which extends from Homer's time to the present day, reveals that the "impulse for creating automata is not originally driven by practical needs" (Reeves & St-Onge, 2022, p. 8). Wikander's anachronistic interpretation of automata as "armchair inventions" designed primarily for demonstrating scientific principles (Bur, 2016) omits the contextual use and 'felt experience' of these inventions, as well as the meanings they convey for both spectator and creator, and the conditions by which the machine operates. A study of the history of automata reveals that these devices were built for very different purposes, "to entertain, to impress or to amaze" (Reeves & St-Onge, 2022, p. 3) – and also to

innovate. In line with Bur and with Reeves and St-Onge, and in contrast to Wikander's view, I argue that automata have instead been 'transcendental devices', as creative, open, and relational (id)entities. They illustrate the nature and relationships between human and non-human bodies, between the mechanical and non-mechanical, portraying the state of our world and perhaps even the cosmos. As the alternative reality, felt and experienced through bounded reality, they were a means for a deeper and more profound meaning of life, and for a palpability, intensification and enhancement of human experience.

The Greek mathematician and engineer Hero of Alexandria designed around 80 mechanical devices, with none of them specifically intended for practical tasks (Reeves & St-Onge, 2022). In his treatise on the construction of automata in the ancient world, he described automata as devices producing spectacles and generating true θαῦμα or 'thaumata' ('miracles', 'marvels'). Experiencing such a miracle was believed to elicit an ἐκπληκτο ('astonishing', 'stunning') sensation in the observer, making automata worthy specifically of the wonder they inspire in their audience (Murphy, 1995; Bur, 2016).

> *Τῆς αὐτοματοποιητικῆς πραγματείας ὑπὸ τῶν πρότερον ἀποδοχῆς ἠξιωμένης διά τε τὸ ποικίλον τῆς ἐν αὐτῇ δημιουργίας καὶ διὰ τὸ ἔκπληκτον τῆς θεωρίας.*
>
> *The study of automaton-making has been considered by our predecessors worthy of acceptance, both because of the ingenuity of the craftsmanship involved and because of the striking and surprising nature of the public spectacle.*
>
> Hero, *Automata*. 1.1.

Hero foregrounds the wondrous effects of automata as the salient feature, which generates inventiveness and miraculousness, and a form of knowledge that is epistemically comparable to philosophy (Tybjerg, 2003). By coupling craft and skill with mystical ingenuity, these artificial beings were driven by long-standing mythological tropes to simulate and surpass the properties of living beings, perhaps even realizing an entirely new entity that mixed the organic with inert materials. "To qualify as an automaton, therefore, an artificial being does not need to be useful" (Reeves & St-Onge, 2022, p. 8). It must simply be able to provide a simulated vitality that provokes wonder and produces a novel and transcending experience.

This inevitably gives rise to questions: Can hybrid devices whose purpose is to entertain and provoke wonder be considered as equally knowledge-producing and as practical as their utilitarian counterparts? Do the element of spectacle and the experiential aspect of technologies devalue the mechanical ingenuities of automata? Does this make them 'lesser' technologies or somehow less 'scientific'?

Emphasizing the importance of the experience of technologies, Cuomo argues that, in order to truly get rid of the 'technical blockade' mentality, we need to let go of the notion of progress as something "better and more efficient" and concentrate rather on the diversity of its scatter functions. She disputes the assumption that there is a pre-designed "linear model of innovation" and evolution when it comes to technology (Cuomo 2007, p. 42). The practical is not confined to mere survival or the fulfilling of appropriate requirements, but also refers to the power to yield up the inner essence of being, thus helping to transform lives and human experience. I believe that the modern myth of the 'proper' use of technology needs to be retold.

In a radical re-thinking of technology's role, David Wills (2008) embraced what he calls the 'technological turn': a form of dissidence, or resistance to a "technology that defines itself as straightforward advancement". Rather, he insists on the technological 'dorsal chance' of that which cannot be (fore)seen, which entails surprise and fortuity, and comes "from behind, from out of range or outside of the field of vision" (Wills, 2008, p. 38). Breaking with the conventions and ideologies of productive technology towards more concept-oriented accounts of technology, I argue for an active revealing and challenging of the unexpected. By challenging our presumed knowledge, this 'technological turn' calls for the emergence of inventive difference and a reversal – or even perverting – of common beliefs, leading us beyond the realm of (presupposed) visual possibility and into the untrusted, the unknown or unknowable, and thereby into endless invention.

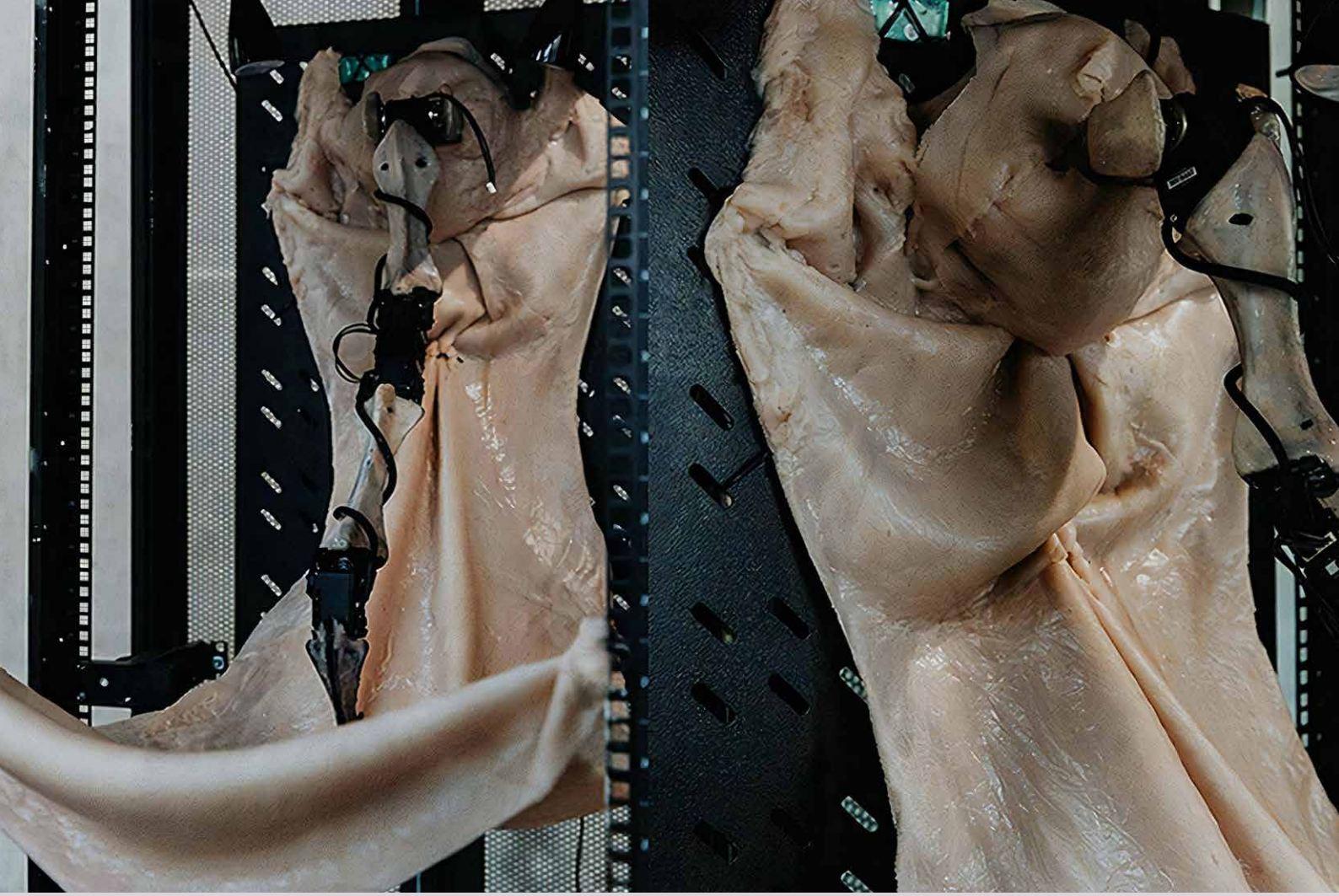
As Nicolas Reeves and David St-Onge write in their contribution to *Foundations of Robotics*, "research in any field is first and foremost a ludic activity, driven by the curiosity and desire for exploration that are inherent to human nature" (2022, p. 26). In other words, we should let go of our utilitarian and goal-oriented notions regarding the 'proper' use of technology and assert instead that wonder-making and the evoking of experience are of equal importance to the image of mechanics. More than mere tools, technologies are the very vehicles by which the inner experience of being is brought forth into a tangible form. They are a potent experience of the imagination, induced with a blend of material, symbolic, affective and cognitive forms, that call for mediation, representation and expression. Technological experiences can therefore reveal something mysterious or otherworldly, as well as unknown, unforeseen and inventive. They can bring out a sense of 'otherness', again occupying

a space beyond the realm of (presupposed) visual possibility. Simultaneously, they can represent sources of the most stimulating fantasy that can evoke novel ways of perceiving the world.

As Gaston Bachelard wrote, "It is not knowledge of the real which makes us passionately love it. It is rather a feeling which is the fundamental value" (cited in Kaplan, 1972, p. 4). Technologies can, therefore, be transcendental experiences, phenomena of surprise that can infringe our core beliefs and systems and lead us towards the unknown and unknowable, forging with it alternate ingenuities and innovations.

These unprecedented innovations confront people with artificial entities that evoke wonder and astonishment. They have created what Robert Hughes called "the shock of the new"' – a sense of surprise and pleasure, mixed with feelings of fear and unease. Grafted upon the imaginary and the real, living and non-living, they are playful and wondrous instruments of knowledge creation and vehicles of experience. Together with hybrids, these ludic mechanical beings generate an enduring curiosity about unusual entities, reminding people of unpredictable, novel and alternative perspectives and understandings.

Science, just as much as literature, myth and art, has always been colored by an imaginary of the hybrid.



Amygdala: MK3 (wax, bioplastic, bioepoxy, aluminum, FPGA computer board, servo motors, 2018)

AMYGDALA MK3

Amygdala was created through a collaboration between experts from diverse fields: robotics, artificial intelligence, material science, art and performance. Autonomous from user control, this chimeric sculpture uses AI algorithms inspired by biological nervous systems to 'learn' in real time how to move and perform in the service of implementing incisions on itself. Biomimetic neural networks endow the machine with artificial cognitive and sensorimotor skills. Sensory data captured in real time by servo motors enable it to detect its own body in space, as well as the bodies of others, and improvise movements in response to external stimuli such as touch, pressure, pull and torsion. As the appendage moves, it gathers information about its environment, constantly modifying its behavior through time. Because we have not programmed Amygdala's movements, but only the way it perceives its body moving, along with the action of the incision, Amygdala's *only* goal is to process information governing how and where to cut, and how to modify its entire body surface further. Amygdala's incised 'skin' is then stored and exhibited separately as an analog representation of robotic body

modifications and patterning. Each skin is unique and bears specific traces and scars resulting from Amygdala's operations ('Calyx' work series, 2019).

IMAGINATION
SPECTACLE
HYBRID
CHIMERA
HUMAN
PROSTHESIS
CONCLUSIONS

Both Beyond and Against

Once you start looking for monsters
you see them everywhere.

Wes Williams, 2011

The notion of hybridity is an ancient one. Deriving from the Latin 'hybrida' (meaning a crossbred animal or mongrel), it initially described the offspring of a domesticated sow with a wild boar. While the exact origin of the word is disputed, the concept evolved to encompass people of mixed descent, who were referred to as such by Roman writers such as Horace and Pliny the Elder (Kurotti et al., 2023) in the first century CE. In his *Natural History*, Pliny referred to hybrids as the half-wild crossbreeds of a "wild variety" and the offspring of "savage races" (Pliny, cited in *Loeb Classical Library*). Referring both to hybrid beings and to the freighted idea of 'miscegenation', these exemplify precursors for the biological and metaphorical foundations of the term.

By the late 18th century – and especially after Gregor Mendel's pea-plant experiments in the 19th century became more widely known – the meaning of 'hybrid' expanded and started to be described as the offspring of any two animals or plants of different species (Stross, 1999). The fact (known to shepherds and farmers for centuries) that some hybrid forms were able to breed posed a challenge to the prevailing Christian view of creation (Kurotti et al., 2023). The existence of fertile hybrids – of a corrupt, unstable and rebellious subject – was considered an aberration, a violation of pure, 'clean' and separate elements through adulteration. This vision of nature as a flux and the possibility of the mutability of species threatened the dominant religious and societal paradigm of the 'natural' order, often represented

as a neo-Platonic 'great chain of being' with hybrid relations between genera implying that it was possible to "break the chain… destroying the integrity of the natural order"[15] (Jenkins, 2015, p. 133).

The human–animal distinction was intrinsic to this paradigm, but was challenged when Charles Darwin explored hybridism in *On the Origin of Species*. His proposition that all living beings (including humans) were interconnected in an intricate "tree of life" (Darwin, 1859, Chapter IX), defied the belief in a divinely ordained world and the supremacy of men. It also sparked a profound re-evaluation of the relationship between humans and animals, bringing forth a vision of a fragile interdependence between human culture and non-human nature. Hybrids were thus seen as violations of God's creation, and the monstrous, the abhorrent – as completely beyond ('outre') and against ('contre') nature (Williams, 2011).

Today, the word 'hybrid' has many fluid meanings and has been reinterpreted throughout history. Its versatility as a notion can be traced across various disciplines and fields such as biology, chemistry, literature, art, politics, technology, social studies, popular culture and beyond. In each of these domains, the 'hybrid' embodies a converging of disparate elements, the mixing and fusion "of differences that cannot simply harmonize" (Cohen, 2009, p. 2). Referring to the offspring, interaction, or entity resulting from the combination of two different species, technologies, languages, or cultures, 'hybrid' serves as a bridge that spans the biological and symbolic worlds. This "slippery, ambiguous term, at once literal and metaphorical, descriptive and explanatory" (Burke, 2009, p. 54) resists fixity and absolute categorization. It is "an embodiment of difference, a breaker of category, and a resistant Other known only through process and movement" (Cohen, 1996, p. x).

Hybrids fall outside ontological categories, breaking down traditional dichotomies and transgressing boundaries. And it is precisely the fluidity of the *hybrid* identity that characterizes its invincible strength.

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15 The idea of the great chain of being represented the universe as an ordered, linear sequence, ascending from the inanimate world of rocks to the animate realm of plants, animals, men (*sic*), angels and, finally, God. It placed humans at the top of a hierarchy of living beings, proposing their exceptional status. This rigid and static scheme was incompatible with any suggestion of change or progress in the natural world. Objects and organisms were locked into an ascending natural order that was closed, complete, immutable and unbreakable. The idea of hybridity of species and transformations from one species to another had no place in this neo-Platonic model so popular among many 18th-century thinkers (see Jenkins, 2015; Nee, 2005).

The hybrid being has recurred time and time again as an aspiration deeply ingrained in our collective consciousness. Blurring the line between reality and imagination, between science and myth, it illuminates and destabilizes those demarcations by which cultures have separated organic from inorganic, organism from machine, and human from non-human. Hybrids – and its equivalent, exemplary 'others', the monster, the cyborg, the chimera, and the almost-human – represent a living embodiment of the potential fusion between humanity, nature, and technology.

In invoking this space of fluid, hybrid identity and 'intercorporeality', these amalgam beings confront us with the question of how these ever-shifting material forms and notions in which human subjects are embodied configure our understandings of 'humanity' itself. What are the material and physical bases underlying practices of identity construction and self-representation in our 'post-human' age? What does it mean to be 'able'-bodied as we transform into hybrids, cyborgs or chimeras?

Rei (bioepoxy, pla, aluminum, biofilm, servo motors, 2019)

REI

Meet Rei – a 'chimeric appendage' resembling the shape of an eyeless beetle. Rather than enhancing the human body, Rei subtracts its original function, blocking its sight with an antenna-like mechanical arm. With the loss of visual perception and abrupt gain of an extra 'limb', one's proprioception becomes largely disrupted, influencing spatial cognition and the sensation of equilibrium. The disturbed body then seeks immediate compensation. It shifts its sensory perception, enhancing and augmenting its own auditory and tactile senses. The bipedal figure transforms, spurred into quadrupedal (or even 'quinquepedal') being, achieving with this metamorphosis a new kinesthetic integration and corporeal harmony. From this crucible of change the Chimera is born, a harmonious fusion of human and machine.

Desire to Augment and Foreshadow

I need you, the reader, to imagine us,
for we don't really exist if you don't.

Vladimir Nabokov (Lolita, 1955)

In her work "A Cyborg Manifesto", Donna Haraway refers to hybrids as cybernetic organisms, as "couplings between organism and machine" (Haraway 1991, p. 6) that represent both a social reality and a world-changing fiction. She calls this non-unitary entity a cyborg, a creature that can "reverse and displace the hierarchical dualisms of naturalized identities... in which we have explained our bodies and our tools to ourselves" (Haraway, 1991, p. 55; p. 67).

The idea of the cyborg, as laid out in previous chapters, has taken various shapes over time. From ancient myths: with artificers like Daedalus and Hermes devising animal-like body appendages; the stories of Hephaestus who made automata and body prosthetics such as an ivory scapula to replace the missing shoulder blade of the hero Pelops; the Norse deity Heimdall who, as noted by Snorri Sturluson, the 13th-century Icelandic poet and historian, had teeth made of gold (Cusack, 2022); the Indian god Savitr whose hands, lost in a battle, were replaced with hands of gold (Cusack, 2022); or the Irish mythical king Nuada, who had a silver hand with motions of every hand therein (Mayer, 2018, Cusack, 2022). By mimicking the powers of gods and animals, these legendary body enhancements are the ancient and medieval equivalents of cutting-edge 21st-century medical technology. They compensated for humankind's vulnerabilities while amplifying its abilities.

Portrayed as half-man and half-machine beings with both robotic and bionic implants, cyborgs symbolize the timeless desire to augment our capabilities that

foreshadows modern advances to enhance human condition. Emerging alongside the idea of hybrids, the cyborg transcends a particular time, persisting as a subject of artistic and technical experiments in contemporary literature, cinema and science.

The symbiosis of human and machine through artifacts, implants, substitute limbs, and bionic body parts is not only rooted in mythology, but also in antiquity. Besides projectile weaponry, like the crossbow and the atlatl or spear-thrower, we have many ancient examples of human enhancement technologies, such as prosthetic add-ons that augment muscle power, strengthen shields and reinforce armor.

Archaeological discoveries have also unearthed evidence of embodied tools and artifacts, proving that we have equipped (and therefore to an extent *embodied*) ourselves with artificially-made objects and aids seemingly forever. By using available technologies, materials and processes, people have been supplementing, augmenting and transforming their bodies since time immemorial. From the first manufactured tools, stone hand-axes dating to around 3.3 million years ago, human-made objects have permeated every aspect of our cultures and activities. Some aesthetic and others more functional, they initiated a number of technological innovations that profoundly transformed both individuals and society more generally (Harmand et al., 2015).

Gray, Mentor, and Figueroa-Sarriera argue that cyborgs already live among us. "Anyone with an artificial organ, limb or supplement (like a pacemaker), anyone reprogrammed to resist disease (immunized) or drugged to think/behave/feel better (psychopharmacology) is technically a cyborg" (Gray et al., 2001, p. 2). So cyborgs can be seen as an intimate union between people and technology incorporated in our motor, sensory, cognitive, and affective systems, delineating our capabilities and defining our identities and experiences in profound and otherwise unattainable ways. As Harraway puts it, "the machine is not an *it* to be animated, worshiped, and dominated. The machine is us, our processes, an aspect of our embodiment" (Haraway 1991, p. 65).

The term "cyborg" was coined by two NASA scientists, Nathan Kline and Manfred Clynes, in a 1960 article entitled "Cyborgs and Space", published in the journal *Astronautics*. It refers to a cybernetic organism, or "self-regulating man-machine system" that can act as "adjunct to the body's own autonomous controls" (Clynes & Kline, 1960, p. 27; p. 74). In more general terms, a cyborg is an entity with artificially enhanced biological functions, supplemented through the use of artifacts or prosthetics.

As the distinctions between human, nature, and technology are being radically reconfigured and combined, our bodies become enduring sites of the limits and

potentials of human nature. The malleable body – beautified, augmented, modified or enhanced through technology (medical and scientific), and literature (fictional and academic) – is viewed and interpreted through constantly changing socio-cultural frames. The ambiguity of body transformations becomes tangible, as it is both internalized by human subjects and externalized as isolated objects of aesthetic and medical contemplation.

But can this ontological mutability of the body be confronted by transforming it into a technological artifact? Might our eternal curiosity for the 'viscera of life' affect the future of our bodies, our flesh?

As we challenge our bodies and the very fabric of our being by merging the biological with the technological, the human and the non-human, the question of what it means to be a living, evolving entity becomes increasingly complex – an enigma waiting to be unraveled. Paving the way for a transformative future is the creature that embodies this intricate fusion, the merging of human, animal, and technological – the invincible Chimera.

Rei (bioepoxy, pla, aluminum, biofilm, servo motors, 2019)

REI

Cave beetles (also known as 'blind beetles') are, as the name suggests, eyeless creatures, living in the dark. They use the antennae connected to their heads to sense their surroundings and avoid obstacles without the need for vision. These antennae, sometimes referred to as feelers, serve as appendages primarily designed for sensory functions, including touch, detection of air motion, heat, vibration (sound), and especially smell or taste. However, they are also adapted for a variety of other purposes, enabling interactions with the environment such as mating, movement, swimming, and anchoring to surfaces. These elongated and highly mobile appendages play a crucial role in providing blind beetles with comprehensive spatial information through mechano-sensation. By rhythmically moving their antennae in vertical and elliptical patterns, these beetles achieve timely detection and an enhanced perception of body vibrations. This alteration empowers them to gracefully navigate their surroundings, deftly sidestepping obstacles and avoiding unexpected collisions.[16]

By creating an antenna-like robotic appendage, I studied how substituting one sensory ability – such as vision – with a novel capability in the form of a limb-like antenna would affect our motor and sensory abilities, balance, and spatial cognition. While these robotic interfaces subtract the function from the body by blocking the wearer's sight, they provide additional spatial and navigation skills through subsequent learning and coordination between wearer and appendage. Consisting of jointed segments breaching into three distinct sections, the antenna-like mechanical limb acts as a performer with its own agency, interacting with its human partner without being controlled externally. The appendage uses AI algorithms inspired by biological nervous systems to gather data in real time governing how to move and perform.

Rei is embodied, perceptual, and cognitive[17] because it can sense objects in its environment through properties linked to those objects (indexical

16 For more details, see Zurek et al. (2014).

17 Much like a blind person's cane that helps in perceiving and navigating their surroundings. For more details, see Heersmink (2022).

properties). This means that when Rei interacts with its surroundings, there is a cause-and-effect relationship whereby these interactions affect its human partner's sensory and cognitive abilities.

The biomimetic neural networks endow the machine with artificial cognitive and sensorimotor skills. Sensory data captured in real time by servo motors enable it to detect the presence of its own body in space, as well as the bodies of others, and improvise movements in response to external stimuli such as touch, pressure, force and torsion. As the appendage moves, it learns about its environment, constantly and iteratively modifying its behavior through time.

IMAGINATION
SPECTACLE
HYBRID
CHIMERA
HUMAN
PROSTHESIS
CONCLUSIONS

Chimera

By the late twentieth century, our time, a mythic time,
we are all chimeras, theorized and fabricated hybrids
of machine and organism...

Haraway, 1991

From cross-bred hybrids to machine–organism cyborgs, crossing so-called[18] species boundaries in unprecedented and wondrous ways has long been the stuff of scientific imagination. Yet this dream has only recently forged a real tangible possibility. Beyond the realms of mythology and science fiction, the unsettling fantasy of the multiple and ultimate species hybrid has staked its claim on the territory of the real, shifting towards the realm of scientific fact. Retaining its fascinating and archetypal form over centuries, the notion of the ultimate Greek hybrid *Chimera* (literally 'she-goat') has made its way deep into the modern imagination and has penetrated the contemporary visions of developmental biology. Once a mere figment of our collective imagination, the vision of a chimerical body has, thanks to modern technology, became a possibility. This suggestive and recurring human fantasy is now driving ideas about practical ways to achieve a synthetic 'nature' using human, animal and technological ingredients.

In 1982, Victor Turner argued that "what was once considered 'contaminated', 'promiscuous', 'impure', was becoming the focus of postmodern analytical attention" (Turner, 1982, p. 77). The artificial production of non-human chimeric beings started

18 The US philosopher Bernard Elliot Rollin argued that the very notion of "species integrity" or "species boundaries" is disputable, therefore the belief in violation of species boundaries by genetic engineering is unjustified (Rollin, 1995).

in 1984, when scientists at the Institute of Animal Physiology in Cambridge (UK) combined embryos from a goat and a sheep (Fehilly et al., 1984). In a reference to the original Greek Chimera, they created a hybrid animal containing cells of both sheep and goat origin, dubbing it the 'geep'. Like chimeras of myth, the geep exhibited morphological traits of both animals, with wool on some parts of its body and hair on others. These new genetic crossings among vastly different species, previously considered untenable from the standpoint of biology, breached once commonly presumed, fixed species boundaries. This new biological reality showed borders between species to be fluid and porous, and in continuous flux. Therefore, the belief in the "independent, unitary, fixed, stable, whole body", which marked the distinction between species, itself became a fantasy (Weinstein, 2003, p. 308), whereas the chimeric myth-like entity was starting to emerge as a new reality.

The removal of reproductive barriers, and thus biological limits, allowed embryologists to start producing human-made chimeras of "dual, triple and even multiple origin" (Tarkowski, 1998, p. 904). What followed were numerous experimental interspecies mixtures (incorporating and mixing cellular material from mice, rats and birds, for instance), some of which seemed to resemble mythological creatures. The first potential tool for helping to create animal–human hybrids was disclosed in 1998 by researchers working on 'advanced cell technology' (Worcester, MD, USA) (Marshall, 1998; Wade, 1998), when scientists fused nuclei from human somatic cells with enucleated cow oocytes to form what they called a human–cow "pre-embryo" (Devolder, 2006). Although this human-bovine hybrid would have existed only in the form of cells, this experiment in stem cell research, dabbling in the creation of what seemed to be half-human creatures, sparked public outcry.[19] It revealed a deep-seated unease arising from feelings of repulsion, fear and curiosity, fed by the same historical beliefs and fears surrounding the cross-species Chimera creature.

So many questions hence emerged: Is the fertilized human–cow egg "human, potentially human or something entirely new?" Should we implant *it* into "a female cow or a female person?" (McGee, 1998, cited in Heffernan, 2003). And what if the embryo were allowed to grow? What if it reproduced?

The controversial idea of 'reasoning' non-human animals and 'bestializing' humans plays on fears of degeneration and physical deviance, as well as concerns about straying from nature's path. What if this sub-human hybrid affiliation is in

19 In response to chimera-oriented research efforts, President Bill Clinton wrote to the National Bioethics Advisory Commission to request an inquiry into "deeply troubling news of experiments involving the mingling of human and nonhuman species" (Clinton, cited in a December 1998 article in *The New York Times*).

fact helping to create a Frankensteinian humanity? Or a super-human with heightened senses? What is humanness if we can customize people with animal features? And what is animality if we can 'humanize' animals?

The fascination and fears associated with these hybrid deviations, as argued by John Block Friedman, are because the latter represent somehow potent forms that can both captivate and terrify. Such entities challenge our understanding of humanity, serving as poignant reflections of the inherent ambiguity underlying traditional notions of what it is to be human (Friedman, 1981). This complex experimental object – or what Hans-Jörg Reichenberg (1997) calls an uncertain 'epistemic thing'[20] and a consequently 'collaborative thing'[21] that is presumed to represent a threat – would, like Mary Shelley's creation, seem to be qualitatively different and superior to naturally occurring animals if it were to have or develop the capacity for reasoning and communicating. It is a threat to our moral status, our social identity, our self-image, and our unambiguous status as human beings, blurring the line between human and non-human 'others'.

As a monster, Chimera was unique. She entered our world mysteriously but, once here, she shaped how we come to think about ourselves and our organic natures, interrogating the constitution and origin of corporeal identity and calling into question the boundary between species. She came to be known as "the ultimate monster of monsters"' (Warner, 1994, p. 10), "the prototype of every possible composite, every hybrid" (Bompiani, 1989, p. 377), whose physical form seamlessly combined features and parts of dissimilar creatures. As an amalgam of any type of human and animal feature, or a fusion of (at least two) different natures or substances combined into a new entity, the Chimera evolved into a broad and generic concept of a "heterogeneous being" (Hinterberger, 2017, p. 455).

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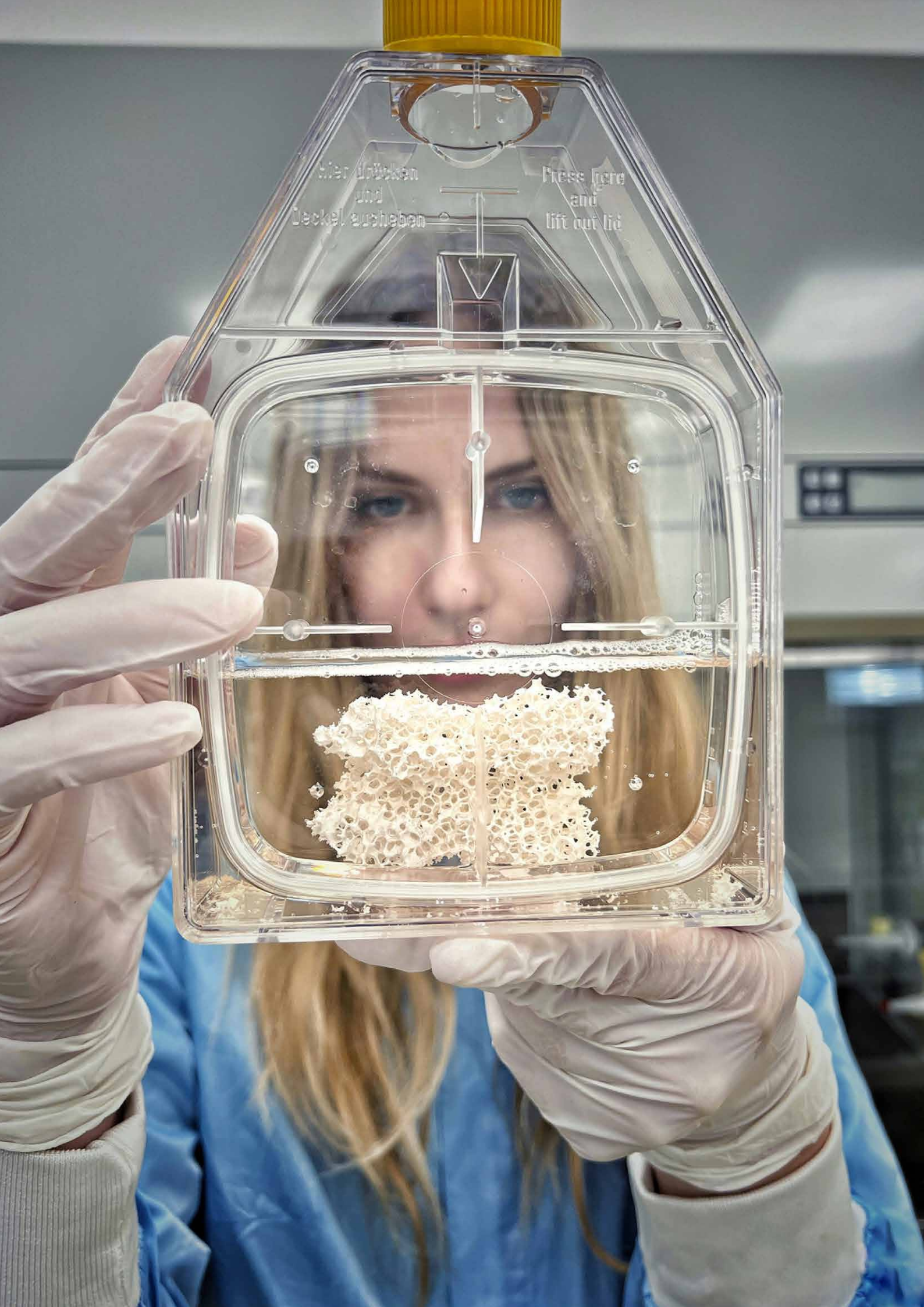
20 Rheinberger suggests that experimentation involves an oscillation between: technical objects – the instruments, devices and biological entities that embody specific outcomes though known standards of purity and precision; and epistemic things – which in contrast represent what we do not yet know in a research project, becoming therefore an object of investigation that can generate questions, enrich reasoning and open new avenues for further exploration (Reichenberg, 1997).

21 'Collaborative things' refers to the research findings or objects that are achieved through exchange across disciplines and clinical practice, and through collaborations that bring experimental openness and potential to facilitate, accelerate, and enhance research processes. For 'collaborative things', the processes of encompassment and the ways in which 'hybrid professionals' work together, engaging the complex technologies and areas of expertise necessary for developing and circulating the research, are more important than the achievement of specific expectations (Michael et al., 2005).

Figure and projection of imagination and reality, Chimera serves as a viewpoint for observing the reconstruction of species boundaries and the intricacies, fragility, and potential of novel biomedical technologies. As symbols of a certain kind of histrionic bioethical deliberation and enthralling figures of modern thought, Chimeras are both liminal and monstrous, beautiful and unexpected, prized for "the insights that they provide into old questions, and above all for the new questions that they continually raise, questions that one never dreamt existed" (McLaren, 1976).


Hier drücken
und
Deckel anheben
Press here
and
lift out lid

Trabecular mimicry in the lab (Educell Laboratory, Ljubljana, SL), 2023.

As the frontier of Chimera possibilities expands, what opportunities might this ambiguity and malleability provide for artists, to not just sculpt but *grow* entire organoids and 'living' sculptures that merge with our very ontology? And if we could grow organs and tissues with custom designs, where then would the art begin and the body end?

As a possibility, through my artistic practice, I posit the notion of chimeric-embodiments using the Reichenberg model of research objects as 'epistemic' and 'collaborative things'. As an epistemic object of investigation, these alternate embodiments can generate novel and unforeseen questions, opening new avenues for further explorations and experiences. This means that each new embodied work is informed by the one before it and informs the one that comes thereafter, functioning together as one entity presented through multifaceted connotations and possibilities. This is achieved through cross-disciplinary collaborations and exchange across spaces and practices, bringing, in turn, experimental openness and potential to enable, accelerate, and enhance the research processes. Specifically, I interrogate knowledge from a diverse array of fields: from art, design, biology, engineering, robotics, artificial intelligence, physics, material science, history, and psychology, creating through this a *chimeric* practice where 'hybrid professionals' work together, and where complex technologies and areas of expertise explore alternate ways of doing, knowing and making.

This *chimeric* approach of epistemic and collaborative represents a bridge between fields and possibilities of 'chimeric embodiments' applications: from investigative creations, scientific-medical devices, exhibition artworks, and participatory installations, among others, these chimeric appendages render the intimate relationships between mind and body public, suspended between art and somatic experience, which can then be communicated to the broader audience, both within and outside of academia.

The Promise of the Monster

The imagination has so much power over seed and reproduction
that the stripe and character of them
remain imprinted on the thing bred

Ambroise Paré, Des Monstres et Prodiges, 1573

The figure of the biotechnological chimera started the process of eroding and confusing the distinctions between fact and fantasy while interweaving the strands of technology and mythology. 'Beings' – once attributed only to gods and mythologies – were now being forged in the crucibles of laboratory science. The uncanny Chimera creature moved from the realms of imagination and wonder to those of the emerging medical and (bio)scientific discourse. The myths we wove became subsumed into engineered artifacts in a tapestry of continuous construction and hybridization.

As previously mentioned, the term 'chimera' was first used by Andrzej Tarkowski[22] in a pioneering 1961 study, when he revealed the capacity to produce mammalian (murine) chimeras by aggregating blastocyst-stage embryos from two different mouse strains (Tarkowski, 1961). He further acknowledged the impact of myths in chimera research in his paper "Mouse chimaeras revisited: Recollections and reflections". He noted that mouse chimeras were "in a way a bow and a tribute paid by experimental embryology to ancient mythology" (Tarkowski, 1998, p. 904). Yet the term itself wasn't originally coined for embryological research, but in the field of

22 "Bird embryologists can produce chimeras closely resembling mythological creatures, for instance an embryo with a chick head and neck on a quail body.... The adoption of the mythological term 'chimera' for description of the product of the manipulations of contemporary embryologists finds full substantiation, and could not be challenged even by terminological purists" (Tarkowski, 1998, p. 905).

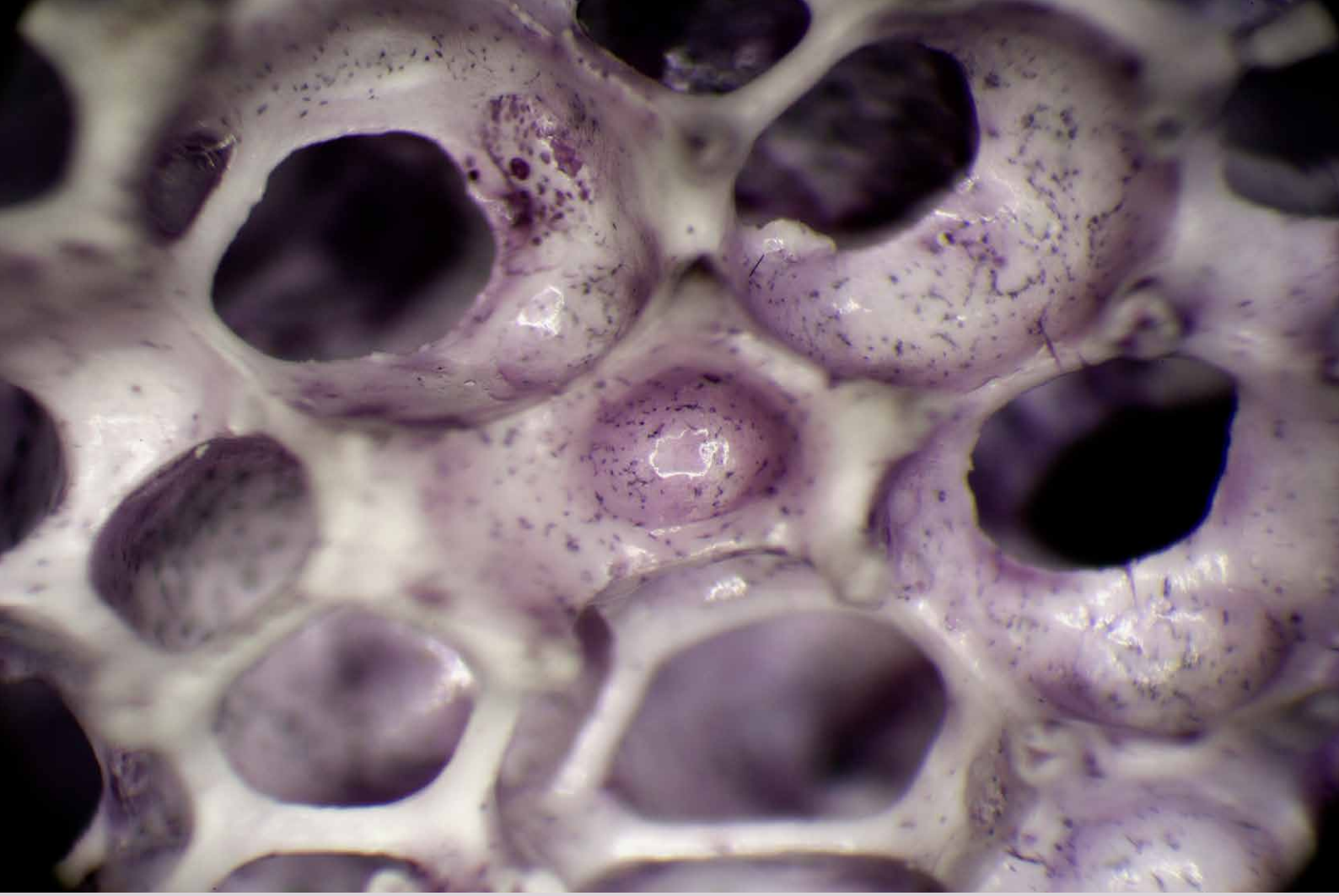
experimental biology. German botanist Hans Winkler introduced 'chimera' in 1907, in a reference to his research on grafting two different species of plants (Hinterberger, 2022),[23] thus transplanting the term from mythology to biology.

The modern realization of ancient fantasy provides us with "the strange and often intimate associations between different species" (McLaren, 1976, p. 1). These chimeric beings, emerging at the boundary between the impossible and the real, defy our corporeal reality and question limitations on sexuality and barriers to propagation. By initiating a renegotiation of bodily integrity, the chimeric entity promotes a re-evaluating of a politics of difference embedded within the body itself: it challenges both the biological boundaries of an organism and the identity politics of diversity, highlighting instead the significance of symbiosis and assemblage (van Loon, 2000). Chimeras negate the categorical and self-congratulatory boundaries not only between humans but also between humans and non-humans (Braidotti, 2013), and supersede previously held 'knowledge' about an organism's reproduction, growth, affiliation and kinship systems (of inclusion and exclusion). As Kath Weston asks, "If kinship can ideologically entail shared substance, can transfers of bodily substance create—or threaten to create—kinship? Can they create—or threaten to create—other forms of social responsibility?" (Weston, 2001, p. 153). Chimerism thus extends the notion of kinship to include non-human animals, while at the same time twisting traditional understandings of 'blood' relations and genetic compatibility. The phenomenon gives rise to questions about culturally established human–animal relationships and the complexity of the links between nature, science and culture.

Calling into question the relationship between the plasticity of biology and fluid connections between humans and other animal beings (Hinterberger, 2017), these modern creatures, like early Chimeras of myth, reject all notions of purity, instead propelling hybridity into our scientific, social and symbolic realms. "Simultaneously relentlessly real and inescapably fabulated" (Haraway 2011, p. 6), they are the "monstrous transgression of boundaries", the ultimate 'Other', the almost-human and a "way to understand ourselves in other life forms" (Hird, 2004). The chimerical body is thus both a promise and a threat of new configurations of

23 The German botanist Hans Winkler, best known for coining the term 'genome', conducted research on grafting two separate species of plants into a single one. He used *Solanum lycopersicum* (tomato plant) and *Solunum nigrum* (nightshade) to create an unexpected hybrid-type plant, which came to be known as the first recognized plant chimera. His 1907 paper *On Graft Bastards and Plant Chimeras* features the first ever use of the term to describe an organism clearly displaying the traits of two different plant species (Hinterberger, 2022).

species, selfhood, kinship and identity. But how can one be such a creature, at the same time lion, snake, and goat? At the same time a cow and a human? At the same time a machine and a person?



The Cell (human mesenchymal stem cells, alumina, 2023)

THE CELL

Over the last two years, I have been delving into the diverse possibilities and meticulous processes and techniques deployed in regenerative medicine and tissue engineering, with a focus on growing tissues outside the human body using stem cells. My curiosity extended to the potential use of these human-derived 'organoids' as artistic materials for my Chimeric appendages. Looking at their relevance for medical applications, as traditional implants, tissue regeneration materials and novel artistic tools, the aim was to bridge the gap between the medical and artistic realms by translating the use of stem cells in medicine into the world of art.

My particular interest centered on the ability to grow bone tissue, considering the pivotal role bones play as the main structural, locomotive, and formative basis of our bodies. Bones not only serve as fundamental support structures for the living but as crucial archaeological clues to the dead, shedding light on ancient civilizations, lifestyles, and evolutionary history. They are tangible records of our past. My exploration

therefore aimed to uncover how altering the very essence of bones and transforming them into novel chimeric artifacts could reshape our understanding of the form, function, and mystery of our existence.

Working closely with scientists specializing in stem cells and regenerative medicine, I focused on human mesenchymal stem cells (MSCs), the primary stem cell type used in regenerative medicine, particularly in tissue engineering and bone repair and regeneration. These cells, commonly found in bone marrow,[24] are responsible for forming bone cells[25] and bone tissue.[26] Our experimenting involved growing these cells at different intervals, exploring the amalgamation properties and possibilities of cell with artificial materials, varying cell numbers and growth-time tests,[27] and using variations of porous alumina[28] ceramic scaffold materials with 3D cellular pores of different densities. Alumina,[29] with its porous body mimicking the structures of the trabecular bone (the spongy-looking porous interior of the bone; see the picture on page 90), proved an ideal substitute pathway for an exploration of Chimera cells, both conceptually and aesthetically.

Inducing cells to grow and develop is a challenging task, given their autonomy as living organisms. But after numerous attempts, our experiments eventually yielded success. The cells not only proliferated in

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24 MSCs can also be isolated from other tissues in the body, dental tissues, umbilical cords, peripheral bloods, dermis, brain, muscle and even tumors. See also de Sousa et al. (2014).

25 Two types of bone cell, osteoblasts and osteoclasts, are responsible for forming the bone matrix and contributing to bone remodeling. Both cell types are derived from multipotent mesenchymal stem cells.

26 Mesenchymal stem cells have the potential to differentiate into various tissues, including cartilage, ligaments, tendons, fat, and bone. These cells are often suspended in a gel, typically collagen, which facilitates the transforming of cells into a 3D model of mineralized bone, ultimately maturing into fully developed bone tissue.

27 The shortest time for cell growth was two days; the longest was two weeks.

28 Alumina is a biologically inert ceramic with particular mechanical properties and is used for manufacturing an array of devices. It has both medical and industrial applications since it is used as a biomedical implant and tissue-engineering scaffold, as well as a material for thermal insulation and for filtering out pollutants in the manufacturing process.

29 Alumina can have a grain size as low as 7 μm. In our application, we used larger pore sizes, starting from 300 μm, commonly employed in industrial applications. This choice aligns with the degrees of porosity exhibited by trabecular bone material, which typically ranges from 300 to 600 μm, although it can exhibit even higher levels of porosity.

number and size, but by multiplying and growing they also exhibited promising potential for the manipulation of organoids. This shows a conceivable prospect for the future of body bioengineering, hinting at the possibility of generating new bodies through advanced biotechniques.

To reveal the successful outcomes of initially imperceptible microscopic entities, we carried out sophisticated methods of staining the material to allow its growth to be detected. Applying specialized dyes, we selectively illuminated cellular features, including the nucleus and proteins produced by the cells, uncovering their presence on visible surfaces. Staining played a pivotal role in the unraveling of intricate details within these biological elements. The ostensibly invisible cells transformed the bone-like surface into various shades reminiscent of flesh, creating a nuanced visual representation. This not only offered an unprecedented naked-eye perspective on the basis of the manifestation of distinct color intensities but also shone a light on the visual aspects of cellular structures as seen under magnification. This approach not only enabled a visual encounter with the otherwise concealed presence of cells but also imparted a deeper understanding of their structure, normally hidden from public view.

Culturing Life

The idea is now hovering before me that man himself can act as creator, even in living nature, forming it eventually according to his will.
Man can at least succeed in a technology of living substance.

Jacques Loeb, in a letter to Ernst Mach, February 26 1890

In scientific practice, there is no single authoritative definition of the concept 'species' (Robert & Baylis, 2003), nor is there a commonly accepted definition of the term 'chimera'. The emerging notion of human–animal mixture in science encompasses a multitude of interpretations, with the term 'chimera' taking on a multiplicity of connotations across various disciplines and contexts. Some chimeras are seen as intraspecies, some are born naturally, while others are created through human intervention. These interpretations are thus often the subject of vigorous debates and discussions. Mostly, however, 'chimera' as a term nowadays describes a single organism with multiple, genetically distinct cell 'lines' (McLaren, 1972). This means that it contains cells, tissues and even organs from two genetically distinct sources within one body. Some inborn examples include maternal cells crossing from mother to fetus, or any variations in body form from both cell sources, having blood cells of different blood types, twin embryos,[30] and 'sex discordant' people with both XX and XY chromosomes, or both female and male phenotypes (Madan, 2020).[31]

30 In humans, natural occurrence of chimerism can take place when 'twin' embryos fuse at a very early stage of development, better known as fusion chimera. In such cases, the developing embryo continues to grow successfully utilizing cells from two separate genetic sources. This can then result in a person with two genetically distinct sets of cells forming different parts of their body (McNamee, 2015).

31 Sex-discordant chimeras can have a normal male or female phenotype.

Concurrently, today's scientists can create chimeras (bio)technically, intervening in the processes of conception, incubation and development through new reproductive technologies. Going back to the embryonic level, and even further towards the profound potential of stem cells,[32] a limitless scientific and technological dream has now been born. From mammalian cell lines in vaccines and horse-urine estrogens in hormone therapies, to the possibilities of xenotransplantation,[33] 3D printing of cells,[34] transgenic treatments and genetic modifications, human and animal tissues are traversed in the "expansive geographies of translational research" (Davies 2012, p. 126) carried out in the fields of medicine, biology, and biotechnology. By expanding reproductive choice through genetic manipulation, developments in biotechnology have offered unprecedented opportunities to accelerate the pace of change, and even bring forth the emergence of new species. And as such, it may even be rendering biology as an artifact of, rather than a limit on, technology (Graham, 2002).

The last couple of decades have seen extensive development of these novel biomedical research organisms. As human brain cells and neural tissue are successfully grown in 'host' mice and monkeys,[35] or sheep fetuses with partly human liver cells and pigs with human blood are generated,[36] these projects prove that cells can be introduced into 'foreign' organisms and structures, surviving and thriving within their new hosts. With the ability to grow living cells outside the body and "harness them to human intention", these chimeric organisms are becoming part of long-standing histories of what Hannah Landecker (2006) calls "culturing life". Once seated firmly in the interior of the bodies of animals and humans, the 'substance

32 The master cell capable of producing any facet of the human body.

33 Cross-species transplantation or xenotransplantation is the process of grafting or transplanting organs, cells or tissues between members of distinct species.

34 Three dimensional bioprinting is an additive manufacturing process similar to conventional 3D printing, used for fabrication of complex biomedical and biological parts, in the field of tissue engineering and regenerative medicine. It uses cells and biomaterials to print tissues and organ-like structures (skin, body parts etc.) that let living cells multiply. Bioprinting was pioneered by Thomas Boland, a bioengineer at the University of Texas in 2000, to print a bioink made of living bovine cells. However, the first Integrated Tissue and Organ Printing System called ITOP, was developed by Dr. Anthony Atala in 2016, and can print cells incorporated within biopolymers (Patel, 2016; Kang et al., 2016).

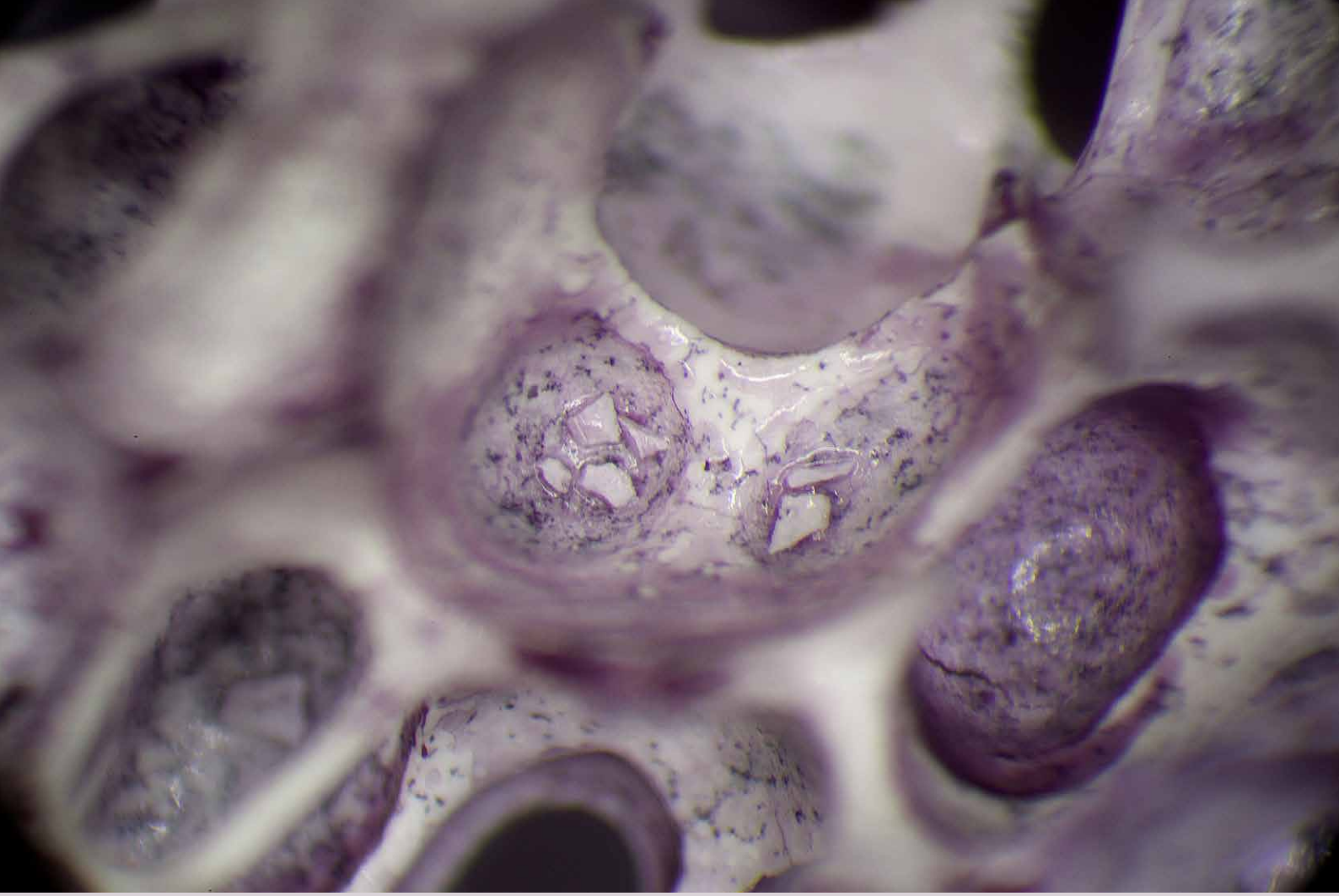
35 IIn 2013 researchers from the University of Rochester grafted human brain cells into mouse embryos, creating human-murine chimeras that displayed improved cognitive function, described as becoming "smarter" (Levine & Grabel, 2017). In 2019 researchers in southern China announced a similar splice that introduced genetic material from a human brain into monkey embryos that afterwards exhibited better short-term memory and shorter reaction times.

36 See Rodriguez et al. (2023), Almeida-Porada et al. (2004), and Cooper et al. 2010) for research examples.

of life' now came to be located in the laboratory, routinely maintained outside any bodily vessel. They are both the catalysts for the formation of all life and novel configuring tools with which to investigate the limits and potentials of human nature. As both leading players and (seemingly) passive participants in our primordial story, these microscopic entities, apparently unassuming, cast their shadows across the landscapes of scientific thought and practice. Emerging and re-emerging in the interplay between subject and object, life and death, internal and external, inborn and engineered, they defy the constraints of biology and push the organic boundaries of malleability and human ability. "Bathed and manipulated internally and externally in countless ways from its genetic constitution to its morphological shape" (Landecker, 2006, p. 3),cells are disembodied, reconstructed and redistributed progressively unfolding, growing, multiplying and transmuting over time, and with this they craft and transform the very essence of our being.

In our age of biotechnological and genetic manipulation, possibilities for the merging of species now present themselves at the molecular level. The distinctions between humans and animals, artificial and biological, 'born' and 'made', external and internal, and inborn and constructed, previously assumed unbreakable, now assume an increasingly variable guise. Simultaneously the essence of life as well as a new scientifically and technically engineered object, this dynamic and malleable living entity reveals that our notions of individuality, (im)mortality, (im)materiality and hybridity are becoming ever more malleable themselves.

From tissue engineering to the realms of reproductive science, culturing the living cell outside the body has turned the cell into material for artistry, and transmuted scientists into alchemists of the living. As living cells became detached from the bodies that traditionally hosted them, they transformed into living materials for artistic expression, turning the essence of life into an untethered and malleable medium. Disrupting the borders between biological evolution and technological artifice, these enduring life entities confront us with the question of how the ever-shifting life-forms and substances by which we as subjects are embodied reconfigure our comprehension of 'humanity' itself. Can this living epitome of change, by navigating a tension between (bio)technological human-derived object and innately human subject, intervene in discourses of medicine and health, or in the debates around what constitutes a 'normal' or 'able' body, by offering alternative characterizations and experiences of embodiment itself? How does this (bio)technological human-derived object influence the idea of the humanly *innate* subject?



The Cell (human mesenchymal stem cells, alumina, 2023)

THE CELL

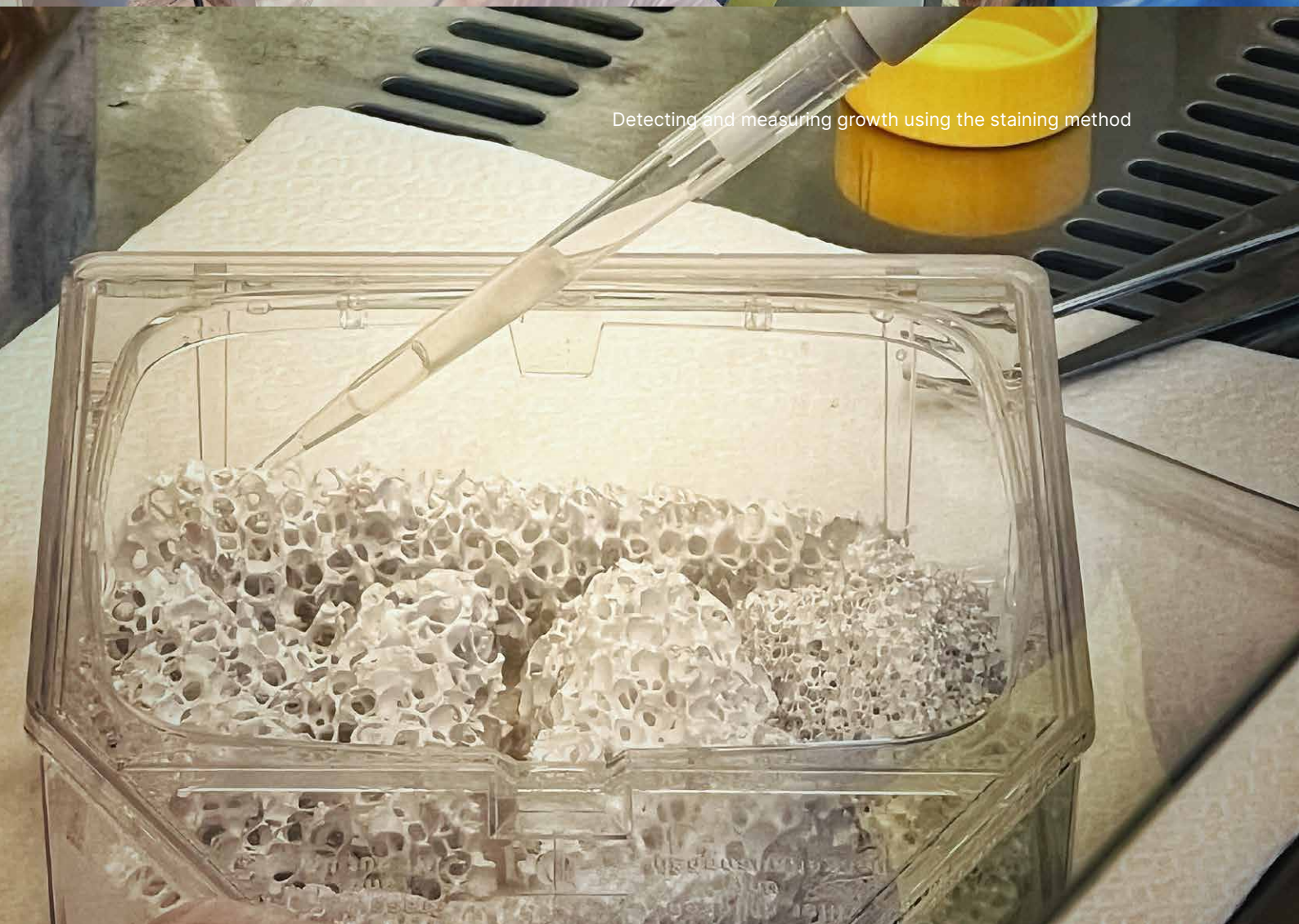
Working with human cells is an intimate, fascinating and nurturing experience. They require continuous care, a gentle touch, an attentive eye, and a duty of fostering within a supportive,amenable and – above all – safe environment. They are bathed daily in an unsullied medium, fed by nutrient substances, kept in warm and blanketed vessels, or cooled down for later encounters. It's a poignant and heartfelt connection, which brings a sense of fulfillment to their diligent guardians as the cells thrive and flourish, burgeon and develop in their own autonomous way. The process can also evoke feelings of culpability – or even shame – when progress is hindered and when cells die (you feel) before their time.

As the human cell becomes integrated into the material, it starts to form bonds within its structure. Life builds itself into sculptural forms, creating a chimeric entity in the heart of the material. This symbiotic dance transforms these chimeric artifacts into something beyond mere representations, evolving as living entities in harmony with the sculptures they

adorn. The inherent ambiguity in the medium therefore offers artists a frontier where creativity shapes not only the forms but also the very fabric of our ontological selves.

The research opened a conceivable potential for these ‘breathing’ materials to be used as personalized bone grafts and as artistic matter for future Chimeric embodiments. Additionally, it has sparked new possibilities for the trajectory of my work, towards ‘living’ body augmentations that blend art, robotics, stem-cell research and biomaterial science.

human mesenchymal stem cells



Detecting and measuring growth using the staining method

DATE: 04.09.2023

Educell Company,
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Ariana Barlič
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Ana Rajčević
Artist and Researcher

Scientific Protocol

Pre-characterized human bone marrow derived mesenchymal stem cells (hMSC) were acquired from a commercial source. Number of cells – 41 million. Differentiation into adipogenic, chondrogenic, and osteogenic lineages has been reported.

Cryopreserved hMSC were kept in liquid nitrogen vapour at -180°C until use. For thawing, cells were incubated at 37°C and mixed with pre-warmed thawing media (DMEM/F-12, 20% FBS, both Gibco). After thawing cells were pelleted by centrifugation at 500 x *g* for 5 min and resuspended in growth media (DMEM/F-12, 10% FBS (both Gibco), 1 ng/ml bFGF (PeproTech) and 1% (v/v) penicillin/ streptomycin (Gibco). Viability and cell count assay was performed by NucleoCounter NC-200 (Chemometec). Viability of hMSC was 92 % and cell number was 40,5 $x10^6$.

Scaffold biomaterial was pre-soaked in growth media for 1h before hMSC seeding. Growth media was removed, and cell suspension was applied onto material dropwise. Cells were allowed to attach for 1h and afterwards growth media was added into cell culture flasks to cover entire pieces of material. Cells were grown on material in a humidified incubator at 37°C with an atmosphere containing 5% CO_2 for 3 days.

At the end of this period growth media was removed and cells were stained by MTT reagent (Methylthiazolyldiphenyl-tetrazolium bromide). MTT, a water-soluble yellow tetrazole is converted into insoluble purple formazan in the mitochondria of live cells by succinate dehydrogenase, an enzyme that cleaves the tetrazolium ring to tetrazole. Water-insoluble crystalline product, formazan, is accumulated in viable cells. For staining, 5 mg/ml MTT (Sigma-Aldrich) was added to DMEM/F-12 to obtain the final 10% MTT concentration. Stained materials were incubated overnight at 37 °C and 5 % CO_2.
Fixing with epoxy…

Almost Human

What kind of imaginary creature is man?
What novelty, what monster,
what chaotic, (self-)contradictory character,
what prodigious creature or beast?

Blaise Pascal, Pensées, 1670

While the technological inventions of the 21st century are dramatically extending human powers, they are also eroding our assumptions about human autonomy, identity and uniqueness. The notion of humans occupying a privileged place of moral and ontological superiority over all other life-forms has long been reinforced by Christianity, and was grounded in the belief in a hierarchical order. Until the end of the 18th century the dominant perspective placed humans in a privileged position between the angels and all non-human animals. Created in the image of God, 'different from the rest of Creation, a little lower than the angels', humans are the possessors of both a soul and a mind, spiritual as well as corporeal beings, set apart and above the rest of the world, 'all things under his feet, all sheep and oxen, and also the beasts' (Psalm 8: 5-8).

As mentioned in the section 'The shock of the new' (pp. 59), with the emergence of Cartesian dualism, the belief that humans are supposedly distinct from and intrinsically unlike other non-human entities was further reinforced. René Descartes' famous assertion "cogito ergo sum" ("I think, therefore I am") ascribes uniqueness to our capacity for cognitive thought, and virtue for reason and language. He posited that animals, plants and nature were composed of mechanical matter, while God was purely of mind, whereas humans were an unparalleled amalgamation of both (Abram, 2010). Descartes' mind–body dichotomy has influenced the trajectory of much European philosophy. However, the advent of evolutionary theories and advances in genetics have challenged this traditional, overly sharp distinction,

destabilizing our purportedly 'divine' status and our superiority over other creatures. As people have been transcending – or transgressing – their biology through the power of technology, effectively extending their sensory apparatus (McLuhan, 1964), they have at the same time been delving ever deeper into their 'other' sides – those of the animal and the mechanistic. Before long, what it means to be human became inseparable from its supposed animal/machine 'other'.

In *The Open: Man and Animal* (2004), Giorgio Agamben examines the separated paths of animals and humans. He writes about the history of the 'anthropological machine' of humanism, as a story of the 'mystery of separation' between humans and animals. Stressing that the concept of human nature is inherently problematic, he concludes that "man [*sic*] is an animal that must recognize itself as human to be human" (Agamben, 2004, p. 26). In other words, for us to truly embody our humanity, we must investigate "not the metaphysical mystery of conjunction, but rather the practical and political mystery of separation" (Agamben, 2004, p. 131).

Although in our more recent history we have been able to broaden our understanding of what counts as human, much of our culture still operates on the assumption that humans are qualitatively different from other entities. This makes the advance of technologies and the possible permeability of species boundaries challenging and uncomfortable for many people. While new technologies provide novel and far-reaching possibilities for human development and evolution, the ways they are applied may threaten bodily integrity, decentralizing the human by blurring the boundaries between humans, animals, and machines. This contradiction and confusion stirs up both technophobic and technophile reactions. Insofar as novel part-human beings are concerned, whether these are animals, machines or – even worse – both, this question is relatively unwelcome in much public discourse.

"If only for a day, and with the complete possibility of reversal, you could technologically transform into any part-human creature – for instance, have your brain implanted into a monkey, your eyes swapped for that of an eagle, tail or body part of a cat, legs or arms of automata – if you could experience any other form of 'being', which one would you choose?"[37] These and similar questions I have asked in countless public situations, casually introducing a colleague, friend or acquaintance to the subject of interspecies chimeras, and most of my probings elicited an immediate, visceral reaction and a strong antipathy to the idea of animal–human–technology permeations. The majority response to a possible breach of our own species boundaries was

37 In 2022 and 2023, during the *Public Research Colloquiums* at Angewandte University in Vienna, I asked audience members exactly these questions.

either to call for a moratorium on further experiments or exhibited a mixture of fear, incomprehension, and denial. From "I wouldn't change anything" and "We don't need technologies for felt experiences or to connect with nature" (while sitting, jetlagged, in a room filled with speakers, projectors, mobile devices, and coffee machines) to "I'd prefer to transform into another human being/take a pill to help me think better/ put on special shoes to increase my walking speed", they all reflected an oscillation between (perhaps unconscious) anthropocentrism and revulsion.

While the idea of partial technological enhancement for human benefit was viewed as perfectly just, the act of imagining an 'unimaginable'-picturing self as a fearful 'l'homme différent'[38] was diverted to the comforting customs of technophobia and taboos. Srinivasan and Kasturirangan (2016), for example, explain this visceral feeling of repulsion as evidence of the drive underlying human exceptionalism to "maintain the ontological and ethical divide between human beings and all other life forms..." (Srinivasan & Kasturirangan, 2016, p. 3). The moral debates surrounding the creation of novel beings, or the 'right' and 'proper' use of technologies, thus derive from an "antecedent commitment to categories that are themselves subject to dispute" (Stout, 2001, p. 158). Simultaneously stirring up issues of ontology, technologies inspire new politics, norms and imaginaries around what the nature of future humans will be. The reactions to artificial beings among the non-specialist public are thus evidence of concerns about transgression and order, and about the ethical, political and social implications of technologies that challenge the boundaries of humanity.

With a nod to St Thomas Aquinas, Michael Hauskeller views this assumption of exceptionalism as evidence of our need to confer on ourselves a 'nomen dignitatis', or a dignity-conferring name. It implies that "being human, and perhaps even being 'partly human', is associated with a particular moral status that is deemed considerably higher than the moral status of non-humans" (Hauskeller, 2009, p. 99). The term 'human' therefore has a persuasive power – the power to put forward and defend one's own ideas of what being human is and what it should be. Therefore, taking Hauskeller's approach, the answer to such questions depends on whether we think that our 'being human' is a result of our language, appearance, capacity for reason, genes, emotions, or some 'higher', supposedly divine spirit. It is determined by "how we justify applying, or denying, the term to an entity", in how we define the essence of 'being human' (Hauskeller, 2009, p. 99). And this is precisely

38 The Romanian historian Lucian Boia refers to imaginary human–animal hybrids as 'l'homme différent', or 'the human other'. In his view, l'homme différent envisages the exact opposite of humanity, therefore our attitudinal reactions to it oscillate between veneration and revulsion.

what spawns so many debates about the status of interspecies chimeras.[39] These are not just debates about making and remaking species and challenging hierarchical boundaries, but about making and remaking deeply entrenched ideologies and felt experiences.

Indeed, according to Robert and Baylis (2003), the standard response of bewilderment on the part of public policymakers reflexively introduces a deeply held set of taboos, biases, and prohibitions. Combining elements from previously distinct categories or allowing objects and actions to deviate from established classification systems is rejected as an example of "anomalous practices that threaten cherished conceptual boundaries" (Robert & Baylis, 2003, p. 7). Our need to force things into existing categories is evident in discussions surrounding the creation of novel beings that are part human. Combining human genes or cells with those of non-human animals is seen as inherently unnatural, consequently evoking an aesthetics of monstrosity and horror. Kelly Hurley points out in her essay "Reading like an Alien" that the ambiguous, defamiliarized human body, as it is rendered 'other', is a symptom of narratives of anxiety whereby the human subject, "dismantled and demolished", is approached as a being "whose integrity is violated" and whose identity borders "are breached from all sides" (Hurley, 1995, p. 205). The underlying worry about the engineering of part-human creatures is thus an anxiety about the creation of certain kinds of novel beings, which would introduce both moral and ideological dilemmas. Our reluctance to imagine technological transformation in the abstract, or to acknowledge our need to glimpse into possible 'others', is thus a repudiating of our potential for novel experiences and our willingness to engage in social and ideological change. Our existing relationships with non-human animals (already problematic) and our future relationships with part-human cyborgs and chimeras would hence give rise to radical challenges. Human to non-human chimeras are neither clearly one nor the other and, as such, they become products of 'abomination'. They are anomalous, loaded with social significance that "straddles the line between us and them" (Stout, 2001, p. 148).

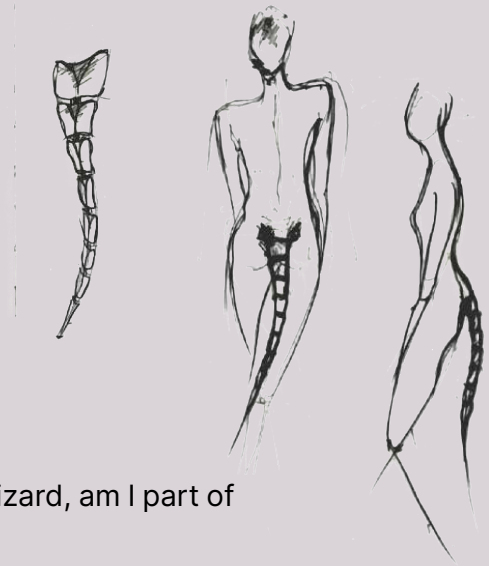
I should again invoke in this context David Wills (2008) and his idea of the 'technological turn' which favors a conceptual account of technology over the strict conditions

39 The US's National Research Council (NRC) has warned that we must be alert to conferring on animals "characteristics that are valued as distinctly human" or "human characteristics that would be ethically unacceptable to find in an animal" (NRC 2005, p. 50, cited in Rollin, 2007, p. 57). Similarly, the Scottish Council on Human Bioethics argues that "if an entity is accepted as having been created by human and non-human beings, then its whole identity and its entitlement to human rights and dignity could be challenged" (SCHB, 2006, p. 7, cited in Hauskeller, 2009, p. 99).

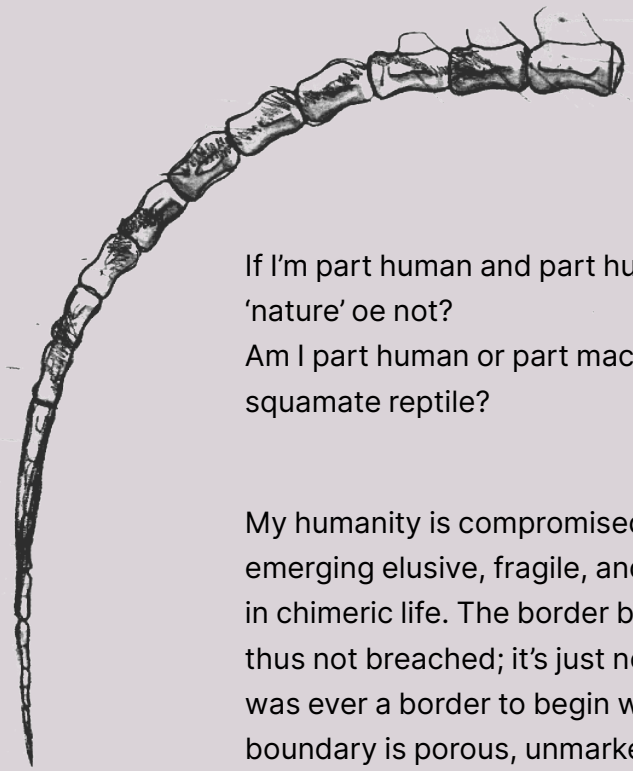
of its production. Wills highlights the need to examine the technologies crucial to our existence, and which remain largely inaccessible and invisible to us when we view ourselves as integrated, self-contained beings with well-defined boundaries. We are thus failing to acknowledge the technologies that influence us from the outside – what he terms the "controlled exteriority of the artifact" – as well as those that affect us internally, beyond our self-imposed boundaries, shaping our identities and experiences, even when they are not immediately visible to us. We need to recognize that we are already prosthetic humans because, in Wills' view, 'dorsality' "no more refers to the symmetrical substitution of the front by the back than does prosthesis refer to the replacement of the human by the inanimate; rather it refers to the articulation of the one and the other" (Wills, 2008, p. 159).

These public reactions therefore constitute an important opportunity: for a self-reflexive challenging of the narratives that underlie our understanding of society and humanity, and a chance to re-evaluate the very nature and role of technology. They offer us an opportunity to pursue alternative frameworks of understanding, knowledge and self-representation, urging us to re-think alterity as a condition of the possible rather than as an excuse for reversal and subjection. By opening up a space for the unassimilable and the unknown, for enhancing or altering our bodily and cognitive experiences, we can (re)define and (re)shape the human experience and what it means to be human. We profess to experience both ourselves and others as human, we erect political edifices and social institutions on this under-explored assumption, but what will happen to *who* we are (our identities) when we change *what* we are (our bodies)? Is there anything about the body that prevents us from devising a different perception of ontology? Is there anything in our bodily experiences that stands solely as human?

(Lizard Chimera-tail ideas, to be created from the cell-bone grafts produced with Educell Company – see chapter Chimera)

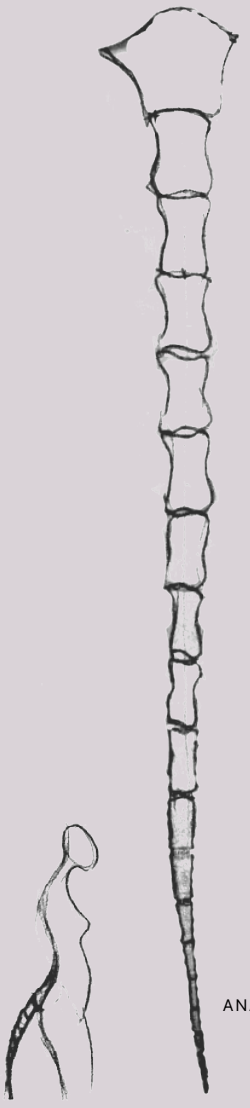


PART LIZARD



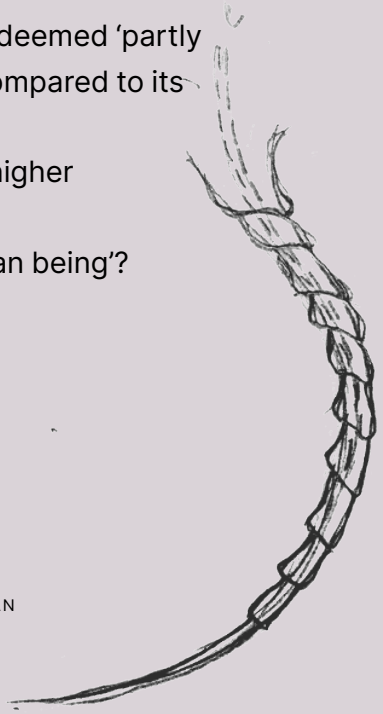
If I'm part human and part human-made lizard, am I part of 'nature' oe not?
Am I part human or part machine? Am I a human being or a squamate reptile?

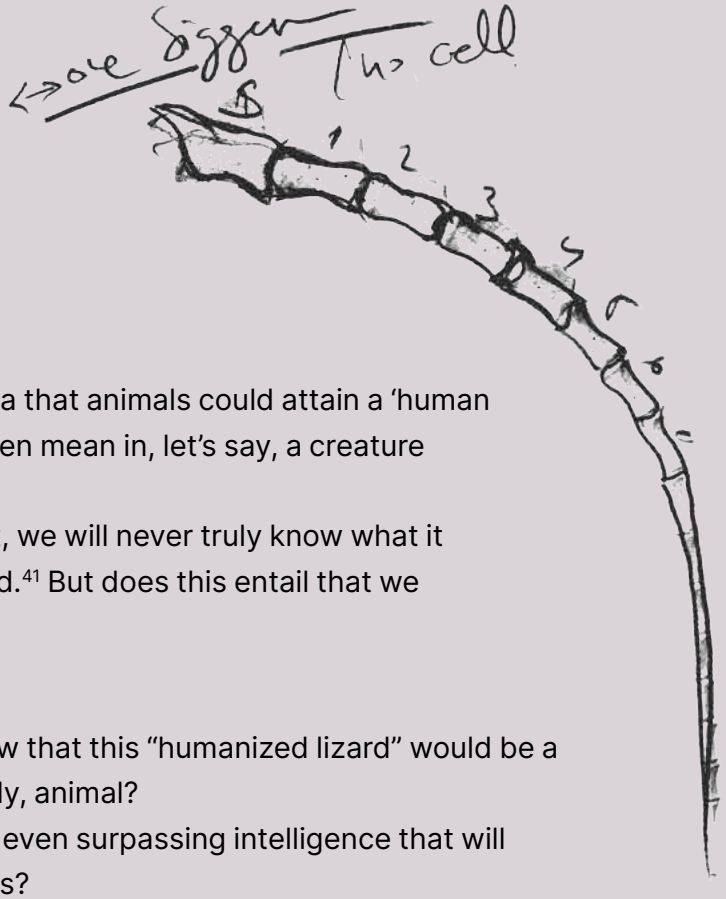
My humanity is compromised – a condition rather than a state – emerging elusive, fragile, and unknown as it becomes entangled in chimeric life. The border between system and environment is thus not breached; it's just not clear where it is, or whether there was ever a border to begin with. The 'border' or the so-called boundary is porous, unmarked.



But should it matter whether I ought to be classified (by whom?) as (part) human, (part) animal or (part) machine?
Am I to be treated the same way as other humans, or as a lizard? Or potentially as something in between – somehow 'better' than other reptiles, although not quite like human beings?

If, with a lizard tail, I am seen as 'partly human', would I enjoy the same moral status as my 'purely' human friends?
And what if a lizard with some of my DNA is also deemed 'partly human' – would it have a superior moral status compared to its 'normal' reptile kin?
Which of us 'partly human' beings would have a higher moral standing?
Which one would be regarded as more of a 'human being'?

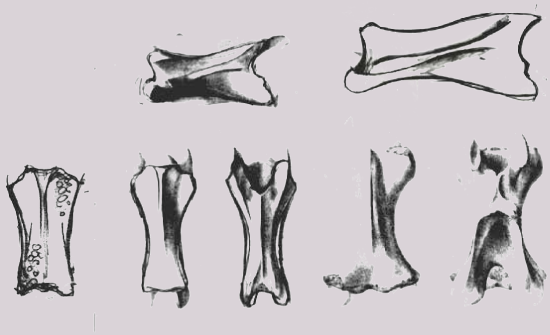




So let's now entertain the idea that animals could attain a 'human intellect'. What would this even mean in, let's say, a creature like a lizard?[40]
Although we might imagine it, we will never truly know what it is like for a lizard to be a lizard.[41] But does this entail that we shouldn't even try?

To go still further: Do we know that this "humanized lizard" would be a suffering, perhaps melancholy, animal?
Or a creature of simulated or even surpassing intelligence that will overcome its human polarities?
How about my newly acquired caudal anatomy – would this characterize me as a being with an extraordinary power?
Or make me a tragic figure in the eyes of others?

A final question: What do *you* believe is more exceptional, my capacity to write these words, or the salamander's[42] ability to regenerate its limbs and organs?
The response will of course depend on who's answering.
I'd say, "Oh, the lizard, for sure."



40 In 2007, Henry Greely and his colleagues emphasized that introducing human neurons into mouse brains does not create a human brain and nor, presumably, a human mind. And whether it enhances the mouse's cognitive abilities or imbues it with human consciousness remains unclear (Rollin, 2007).

41 To paraphrase the argument propounded by Thomas Nagel in *What is it Like to Be a Bat?* (Nagel, 1974).

42 Among vertebrates, salamanders are one of the organisms that are able to regenerate a broad range of tissues and organs, such as the limb, heart, spinal cord, and lens (Gómez & Echeverri, 2021).

Nearly Whole

I dreamed I was a butterfly,
flitting around in the sky;
Then I awoke.
Now I wonder:
Am I a man
who dreamed of being a butterfly,
or am I a butterfly
dreaming that I am a man?

The Zhuangzi text, 369–286 BCE

This "western" contempt for humanity, the belief in our exceptionalism, reinforced by the Cartesian nature–culture and human–non-human dichotomy, is not really endorsed by other cultures. Indigenous ways of knowing, for example, speak of "the transpersonal self" (Sahlins, 2008, p. 48), of reciprocity and interconnectedness between people and the natural world, ascribing equal personhood to all beings (Mazzocchi, 2006). The Chewong society of aboriginal people in the Malay Peninsula, as described by Norwegian anthropologist Signe Howell, are bound up in a state of symbiosis, between humans, other beings, non-humans and objects such as those made up of artifacts, plants, animals, and spirits, into "one extended society" (Howell, 1984, p. 4). The classical schools of Chinese philosophy also subscribe to the notion of non-anthropocentrism. In the so-called trinity of heaven, earth and man ((天地人, *tian-di-ren*), along with the associated forces of yin and yang which humans are inherently part of, are necessarily in unity with nature (Bing, 2021). Similar principles of interrelatedness and interdependence can also be found in African and other Asian ontological discourses that emphasize the material and non-material, plants or animals, whether biotic or abiotic, as embedded into a whole.

In *The Question Concerning Technology in China: An Essay in Cosmotechnics* (2016), philosopher and researcher Yuk Hui suggests that the distinct cultural and historical perspectives of the "west" and "east" fuel very different approaches to and views on technological advance. While the west views technology as primarily a tool for economic development and progress, China's emphasis is on the spiritual and philosophical aspects of technology that comes from the harmony and balance between humanity and the nature of traditional Chinese philosophy. Moreover, for

the Chinese, the ultimate existence of the universe is that of constant change, traced back to the *I Ching* or "Book of Changes", written between 1000 and 750 BCE (Kern, 2010), rather than the notion of 'being', which implies a static existence and was a theme in much 20th-century European thought, from existentialists like Heidegger and Sartre to post-modernists like Barthes (Bing, 2021). Thinkers based in "the west" often seem hesitant in the face of certain technological developments, such as Chimera research or AI, while China's view of these frontier technologies is more pragmatic, due to that culture's arguably higher levels of acceptance of uncertainty and change.[43]

Could we attain and embrace a more non-western perspective on our present and possible futures, and a new thinking about humanity in the context of all life? Would this maybe lead us towards possibilities of taking alternative perspectives, allowing us to think beyond the boundaries of our selves?

As Marshall Sahlins (2008) notes, the self does not exist as a "bounded, unitary and autonomous individual" as in much of social theory, but is rather formed from many 'others' to whom the individual "is joined in mutual relations of beings" (Marshall, 2008, p. 48). Technological advances are demonstrating that we have never been just biological entities. Instead, humans, along with other organisms, are composites of many species (such as micro-organisms) living, developing and cooperating together in what is known as endosymbiosis.[44]

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43 While western countries engaged in intense ethical and policy debates on embryo research due to the development of in vitro fertilization in the 1980s and embryonic stem-cell research in the 2000s, Chinese researchers remained relatively untroubled by such controversies (Peng et. al., 2022). In western cultures, embryos are considered to have a special moral status, particularly rooted in Catholic thinking (Żuradzki, 2014), while in China the moral standing of embryos occupies perhaps a more neutral position, devoid of notably religious overtones. This means that while China's stem-cell research policies grant protection to human embryos, they do not assign them equal moral or legal status as human beings (Peng et al., 2022).This has allowed China to be relatively agnostic about the potential expansion of the 14-day chimera embryo rules, which encouraged some US and European scientists to outsource chimeric research to China to circumvent restrictions in their own countries. One such example is the creation of the first human–monkey chimera in July 2019, by a team led by Professor Juan Carlos Izpisua Belmonte in collaboration with the Murcia Catholic University in Spain, but conducted at the Chinese Academy of Science's Kunming Institute of Zoology (Tan et al., 2021).

44 In a 1967 article "On the Origin of Mitosing Cells" in the *Journal of Theoretical Biology*, Lynn Margulis championed the theory of endosymbiosis, proposing that the main driver of biological evolution is not competition but cooperation (Gray, 2017). In other words, only the existence of cooperation makes evolutionary dynamics possible. Moreover, some argue that cooperation may have been of utmost importance for the appearance of the first life-forms. The idea undermines two key pillars of evolutionary theory, the dogma of competition and the principle of individuality. Every organism hosts a complex ecosystem of other organisms living together in symbiosis and constantly cooperating with one another. A huge number of bacteria and other micro-organisms contribute to ontogenetic development and are an integral part of every organism. They are fundamental to

By calling into question the ontological purity which many western cultures have set as a precondition for humanity, this new biological perspective effaces individuality, opening an avenue to a more unexpected plurality. The philosopher of biology John Dupré (2015) argues that we need to start thinking more about ourselves and living systems as diverse, disparate elements working together (Dupre, 2015; Hinterberger, 2017). In other words, we are 'poly-genomic' creatures or, as Donna Haraway once said, "We are all Chimeras" (Haraway, 1991, p. 7).

As the category of the human becomes less familiar and clear once it has been intermingled with chimeric alterity, this blurring raises questions about the apparent 'boundaries between species' and the subjectivity of 'other' participants. As we absorb the 'other' into us, the question becomes no longer where, but whether, we can draw any lines between 'us' and 'them'. The presumed individuality and separateness of beings thus becomes elusive, pushing us to rethink our humanity, and alter our ideas of plasticity and hybridity. If we are already chimeric organisms, then is the potential of part machine–part human (or part lizard–part human) such an aberrant and dreadful thing to propose? Could these trans- or poly-genic creatures paradoxically enhance our humanity, helping us get rid of the idea of the segregated being, thus opening up a space for an integrated whole? Could it contribute to a re-evaluation of the status of animals and technologies in relation to humankind?

Scientific research shows evidence that characteristics of "sentience, intelligence, empathy and altruism", including genetic micro-chimerism, are shared by human and non-human species alike (Creed, 2018, para. 2). Then why do we still believe in the exceptionalism of the human species? Boria Sax suggests that the people of the future might consider heredity and hierarchy to be less important than form and substance and, in consequence, "declare the whale once again to be a fish" (Sax, p. 76). So how people of the future will classify creatures may largely depend on what qualities and properties they deem to be (more) interesting and essential.

The arguments of Rollin (2007) and Hauskeller (2009) about fixity and the morality of crossing species boundaries, as well as the essay by Robert & Baylis (2003),[45] lead

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the survival of the host. They regulate its anatomy, physiology, immune response, development, and behavior. For more details, see https://undsci.berkeley.edu/wp-content/uploads/2022/08/endosymbiosis.pdf

45 "In the debate about the ethics of crossing species boundaries the pivotal question is: Do we shore up or challenge our current social and moral categories? Moreover, do we entertain or preclude the possibility that humanness is not a necessary condition for being granted full moral rights? How we resolve these questions will be important not only in determining the moral status and social identity of those beings with whom we currently coexist (about whom there is still confusion and debate), but also for those beings we are on the cusp of creating" (Robert & Baylis, *Crossing Species Boundaries*, p. 10).

to some final questions: Is 'human-ness' therefore the only precondition for whether an entity should be granted full moral rights? If technology can supposedly surpass or under-perform human abilities, what then are the bases for comprehending human uniqueness? How is the corporeality of the body addressed when coupled with emerging technologies such as AI, gene editing and gene splicing? How do these novel processes challenge the notion of humanity itself?

(pla, aluminum, servo motors, 2019-2020)

C |

C is a robotic chimeric-artifact that endows human subjects with non-inherent physiques and abilities, such as caudal animal anatomy. It studied animal morphology, locomotion, sensing, actuation, and mechanics as a means to design novel augmentative capabilities and experiences.

IMAGINATION
SPECTACLE
HYBRID
CHIMERA
HUMAN
PROSTHESIS
CONCLUSIONS

The Prosthetic Metaphor

If a man whose eyesight is fading
takes some eagle's gall,
and mixes it with Attic honey
he will see again
but with extreme sharpness of vision.

Claudius Aelianus (1884–1969)

The oldest leg prosthesis on record was discovered around 2007/2008 in a tomb in Shengjindian, an ancient cemetery near Turfan, China. Archaeologists uncovered the remains of an elderly 50-65 year-old man, dating to the third century BCE. The skeleton was buried with a simple yet innovative leg prosthesis made of wood, with a horse's (or donkey's) hoof affixed to its base and joined with a sheep's or a goat's horn (Xiao Li et al., 2013). This horse-like prosthesis was attached to the man's leg, functioning as a straightened 'third leg'. Acting as both a replacement and an addition to the lost mobility of the disabled limb, this animal-inspired artificial limb is the only known case in the pre-modern world where a hoof has been used prosthetically. It also shows a keen understanding of the biomechanics of certain animals and how they can be adapted and employed for human needs (Dennis, 2022).

Although the use of technological supplements has a lengthy history, the term 'prosthesis' was not introduced in medical literature until the early 18th century. According to David Wills, in his book *Prosthesis*, it referred to the "replacement of a missing part of the body with an artificial one" (Wills, 1995, p. 218). Applying to a therapeutic device in both a medical and a cultural sense, the term reflected the commonly accepted discourse of the singular human being, of the 'whole' and normative body, thus "making the 'whole' of the disabled person, or the re-establishment of normative life" (Shildrick, 2022, p. 32). The word derives from the ancient Greek term πρόσθεσις ('prostithenai'), denoting an 'addition', 'application' or 'attachment',

or 'that which is added to the body' (Vocabulary.com. n.d.). These different connotations signal its dual and almost contradictory applications and the metaphorical significance attributed to it.

Whether referring to an external or internal device – a replacement, repair, addition, attachment, extension or enhancement – the transformative and affective significance of prostheses destabilizes our idea of normative corporeality, opening up a space for corporeal indeterminacy.

The pairing of a dis/abled body with a non-human anthropomorphic form of prosthesis is quite rare in contemporary prosthetic design, yet another attempt towards this direction occurred some 2,300 years later. Van Phillips, a biomedical engineer and amputee himself, designed the famous Flex-Foot prosthetic blades, inspired by the hindquarters of the cheetah. Considerably dissimilar from the Turfan hoof prosthesis yet analogous in its aim, this unconventional non-anthropomorphic aesthetic embodied the human wearer with the attributes of another species. Deliberately avoiding any attempt at replicating a typical human leg, Phillips' prosthetic design prioritized a particular animal's musculature by imitating the running capabilities found in the hind legs of a cheetah (De Boeck & Vaes, 2021). Surpassing all prior endeavors rooted in human-inspired designs, they became the most advanced prostheses used in athletics. The impact of this cheetah-inspired design, both scientific and cultural, led to widespread debate around the potential of physical augmentations to supplement, enhance and even replace human abilities. As both enhancement and replacement, the Flex-Foot underscored the complex interplay between notions of 'disability' and 'hyper-ability', signposting a transformation in our interpretation of able-bodiedness. The prosthesis ushered in a paradigm shift, by propelling an anatomically and functionally lacking body – normatively judged to be 'disabled' –beyond the mere concept of 'abled', instead elevating it as "super-abled".[46]

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46 Before the advent of the 'Flex-Foot Cheetah', amputee athletes were seen as competing at a significant disadvantage in comparison with their able-bodied counterparts. But with advances in prosthetic technology, a substantial shift has occurred, leading to debates about whether these carbon-fiber prosthetic blades gave an advantage to some athletes. When the Paralympian (and world record holder) Oscar Pistorius won a silver medal at the South African national championships, the International Association of Athletics Federations commissioned a study to determine whether 'Cheetahs' conferred an unfair advantage. Based on a biomechanical study performed by Professor Gert-Peter Brüggemann at the Institute of Biomechanics and Orthopaedics at the German Sports University in Cologne, it was concluded that Cheetah prosthetics indeed provided a technologically based advantage, in effect making Pistorius 'super-abled' and thus ineligible to run against able-bodied competitors, including at the Olympics. The determination that an athlete with Cheetah legs consumes less energy than an able-bodied athlete running at the same speed, making the Cheetah legs presumably more efficient than biological legs, was overruled five months later, on the basis that the initial ruling had made normative rather than biomechanical comparisons (Zettler, 2015;

The word 'prosthesis' takes on a profound ambiguity, occupying a space between biology and technology,[47] resonating with notions of body–machine interfaces (like cyborgs) and technological artifacts that mediate human relations.[48] In broader terms, a prosthesis can be viewed as any machine, technology, graft or tool that intervenes in human subjectivity, specificity, ableness and agency (Ott et al., 2002). As Antje Jackelen suggests, there are three possible applications of prosthetic technology: to repair "what had been broken", to correct 'defects' people are born with – as in 'correcting nature' – and the 'optimization' of the healthy, or what she calls "improving or even overcoming nature" (Jackelen, 2002, p. 292). Prostheses have thus become, as Sarah Jain argues, "discursive frameworks as well as material artifacts" (Jain, 1999, pp. 32-33), expanding our understanding of the variability and unpredictability of the human body, underlining its malleability and potential to extend and breach its 'natural' borders. They reconstruct both body and mind, expanding its limits and thus creating different and unpredictable kinds of human experience and hybridity. As a versatile metaphor and a material reality, the prosthesis gives rise to unseen and unforeseeable possibilities.

Subverting normative expectations of prosthetic limbs as mimetic human-like replacements or add-ons, Phillips' animal-like prosthetics opened up possibilities to engineer bodies into novel and non-anthropomorphic designs. They initiated the transformation of the human and a new range of embodied forms and cognitive capabilities, creating a space for fresh thoughts, experiences and morphologies, and helping to foster a new understanding of hybrid inter-corporeality.

In this conception, I see prosthetics as a radical tool that can help us re-think boundaries and interrogate notions of 'normality', informing novel possibilities of the body's malleability. As the properties of those materials with which we sculpt ourselves transform our perceptions of 'mutated' or differently abled bodies, the question is whether they can also generate alternative experiences of being. Can they lead us towards more powerful and liberating possibilities for what humans could be or become?

I aim to seek out a new role for prosthetics: one whereby they serve as catalysts for reconfiguring the discourse around technology advances, approaching them as devices with socio-political connotations and implications which can help us imagine, explore and navigate our possible futures.

Booher, 2016).

47 Within the field of Science and Technology Studies, and especially the area of body theory.

48 Such as a computer, telephone, bicycle or car – serving as notable illustrations of how these prosthetic devices influence the way we think, perceive, move, and make choices.

Mechanical Bloom, (rubber, nylon, pla, servo motors, 2022)

MECHANICAL BLOOM

The Mechanical Bloom is an enigmatic yet social creature, an 'uncanny' organism with its own autonomy. It operates as a social machine, engaging with people, yet its interactions do not consistently convey a sense of care or concern. While this enigmatic creation 'invites' you to engage with it, beneath its exterior lies a deliberate detachment – it fulfills no functions nor makes connections, providing a canvas for spectators to project their own perceptions onto its seemingly purposeless actions. This (anti)social machine[49] operates autonomously, following its own whims, while the audience confers meaning, injecting the spectacle with layers of interpretation and subjective understanding, even though the robot remains indifferent to its audience's presence and expectations.

Inspired by the segmented body parts of centipedes and scorpions (arachnids),[50] 'alien'-looking creatures evoking fear and disgust in many, 'the mechanical bloom' defies convention – unable to perform any designated function, pursue specific goals, foster connections, engage in care – it represents a device practically useless to humans. It has been designed to be devoid of utility, instead serving as an exploration tool for spectacle and a heightened awareness of human-centered experience.

49 Social robots transcend mere machinery, engaging with humans and each other in a socially 'acceptable' fashion. They convey intention in a manner perceptible to humans and have the capacity to engage in goal-directed behavior. Whether acting as a personal assistant, a companion pet, a trusted friend, or even a therapeutic ally, these robots epitomize a new frontier in human–robot interaction, where technology converges with the intricacies of social dynamics.

50 Spiders, scorpions and centipedes, while mostly harmless, often generate high degrees of fear and disgust, and are disliked by many. Devoid of facial features that we can easily relate to or connect with, these alien-looking creatures, with their flexible armatures and abundance of limbs, offer a stark contrast to the familiar and biddable pets we typically adopt.

Mechanical Bloom, (rubber, nylon, pla, servo motors, 2022)

In this paradoxical convergence of the social robot devoid of conventional utility and 'instinctual' aesthetic acceptability, the mechanical bloom is a blank canvas for our imagination. By inviting spectators to project their own meanings onto its purposeless actions, it challenges preconceived notions of functionality and connection, urging us to contemplate the essence of interaction beyond mere utility. This eerie organism is drawn from creatures many of us instinctively recoil from, challenging us to reconsider the criteria by which we judge the desirability of robotic 'companionship'.

In this exploration, *The Mechanical Bloom* prompts us to reflect on the multifaceted nature of our relationships with technology. It invites us to question whether our desire for robotic interaction is rooted solely in functionality and predictability or whether there exists a deeper, more instinctive yearning for connection and the 'understanding' of another entity. Ultimately, these creations call on us to embrace the ambiguities and complexities inherent in all human–robot interaction.

In collaboration with roboticists, engineers, choreographers, and performers, we explored and evolved various robotic research areas and principles, such as pneumatic artificial muscles[51] and 'shape-memory' polymers,[52] using various actuators and techniques to test robot movement possibilities and levels of resistance. We also tested various fabrication processes, from flexible and inflatable to rigid. The eventual robot uses a bidirectional, tendon-driven system[53] which moves an appendage in multiple directions with the aid of nylon 'tendons'.

51 The control method employed in so-called 'soft' robots relies on changing the pressure inside a flexible tube, allowing it to function like a muscle that can contract and extend, exerting force on its attachments. Through the use of valves, the robot can maintain a given shape using these 'muscles' without requiring additional energy input. This method typically involves an external source of compressed air to function effectively by exploiting differentials in air pressure, using the same physical principles as those that powered the singing birds of Ctesibius (see page 54).

52 These 'smart', reconfigurable materials use thermal actuation to 'remember' their original shape and revert to it when the temperature increases.

53 Strands of nylon material are connected to actuators and routed through the structure of the robotic limb. Bidirectional motion is achieved by selectively tensing or releasing the tendons.

IMAGINATION
SPECTACLE
HYBRID
CHIMERA
HUMAN
PROSTHESIS
CONCLUSIONS

What If

Que serions-nous sans l'espérance de devenir un jour différents?
Where would we be without the hope of one day becoming different?
Lucian Boia

Let's play.
Let's play a game.
Let's play a game of "What If...
...you could remake your entire body from scratch?

Beyond the wildest dreams of Homer, Ovid, and Darwin, scientists today can physically implant technologies within the body, 'printing' and growing organs and tissues from its substance. They can augment human forms and capabilities using artificial means, with both internal and external supplements, they can clone species, create human–animal chimeras and program the operations that govern the self-replicating of micro-organisms.[1] From upper and lower limb prostheses, exoskeletons, implants, biological and artificial grafts,[2] to the embryonic stem-cell manipulations of chimeric creations, technologies are increasingly

1 For instance 'xenobots', or biological objects – a computer-designed collection of cells.

2 Biological skin grafts are tissues 'harvested' from one part of the body and transferred to another part, on the same creature or from one creature to another. Synthetic grafts, on the other hand, are alternatives to biological grafts; the former have been designed to mimic the characteristics of a biological graft in terms of strength, compliance, elasticity, and durability without side effects. They can be human-made from synthetic materials (such as polymers, ceramics, metals, and composites) or grown in the lab using living cells and organic or chemical 'scaffolds' – made from the same synthetic materials with or without biodegradable properties – and are usually referred to as bioengineered grafts.

being embedded for reconstructing, enhancing (and perhaps even substituting?) the human being. With the possibility of being internalized and externalized by organic tissue and incorporated into its very structures, technologies have turned our bodies into a testing ground for design and engineering, a malleable material to experiment with. This enviable power to (re)imagine and (re)shape future people has changed our perceptions of the body, rendering new bodies alterable by science.

While these technological experiments may help us unravel some profound biological questions, they also pose ontological challenges that may permanently transform our perception of human existence. As research tools, discursive objects and what Rheinberger calls "epistemic things" (Rheinberger, 1997), the Chimera creatures have already been created, breaking down the barriers between human and non-human. Standing on the margins of moral controversy, they confront us with the issue of how far technological interventions can be implemented without changing a human into a distinct species. By evoking an inevitable hybridity, Chimera therefore prompts us to consider the vexed matter of exclusion and acceptance: If we radically alter the human, by merging human with animal and machine, will we still be 'human'? And if society embraces these (in)voluntary alterations, then what, and whose, visions of this contestable future would it be plausible to create?

The power to re-engineer species and merge the artificial with the organic has been significantly streamlined thanks to the advent of a gene-editing technology known as CRISPR-Cas9.[3] Described as 'genetic scissors', this simple yet powerful tool allows us to surgically add, remove, or alter any DNA sequence, replacing it with alternative strands of DNA code. Its application can engineer bacteria, plants, animals and humans with entirely new traits, empowering 'us' with the capacity to manipulate life at its most fundamental level. This newfound capacity to modify and perhaps guide the evolution of species has opened up further space for the creation of novel entities, including human–animal Chimeras (Enriquez & Gullans, 2015). But CRISPR's ingenious method isn't merely a human invention. It is actually a mimicry of natural and ancient processes that function as a bacterial and primeval immune system, and a mechanism that serves as a defense against viruses[4] (Fernholm, 2020). By

3 Short for "clustered regularly interspersed short palindromic repeats", CRISPR is an efficient, rapid, and large-scale gene-editing tool that allows for precise changes to be made in the genes of all living organisms, including modifications to the human genome.

4 Micro-organisms use CRISPR to defend against viruses. When a virus invades a bacterium, Cas proteins act like molecular scissors, cutting out a piece of the viral DNA. This piece is then stitched into the bacterium's CRISPR region, creating a genetic 'memory' of the infection. This RNA molecule binds to a specially associated protein called Cas9. It is these resulting complexes which act as the 'memory' that immunizes organisms against repeats of past infections. If the virus invades

emulating this innate biological capability that some microbes have, Emmanuelle Charpentier and Jennifer Doudna[5] discovered its capacity to be used as a tool at the molecular level, translating it into a potentially life-changing (super-)ability. Once again, the human desire to advance knowledge and transcend one's own corporeality through the study and imitation of nature has proven to be feasible ingenuity. It has gradually transformed the once-imaginary creature of the Chimera into a tangible reality, turning the realms of folklore and fiction into the realms of existence.

Rather than inventing entirely novel concepts, much of human design, whether industrial or scientific, draws inspiration from, or mimics, the natural world. Using the animal world and biology to inspire human ingenuity, we have created effective and revolutionary materials, structures, tools and mechanisms (Bar-Cohen, 2005), as argued in the preceding chapters. In the words of Francis Bacon in *The New Atlantis*, "We imitate… flights of birds. We imitate also motions of living creatures by images of men, beasts, birds, fishes and serpents" (Bacon, 1627/1983, p. 485), facilitating the transference of innovative capabilities to both art and technology. The original attempts to imitate life by artificial means paved the way for people later to use the principles involved in developing more complex mechanisms for industrial applications. Mastery of flight was inspired by birds, while the shape of whales led to submarine designs (Lee, 2011). The wings of bats influenced the development of 'wingsuits'[6] while the hammer-like action of the woodpecker's bill led to the design and function of a range of powered tools (Harman, 2013). Swimming creatures that have webbed feet (like geese, swans, seagulls, seals and frogs) have shaped the creation of fins, transforming our rather terrestrial physiology aquatic. Not only do fins increase the propulsion surface, which in turn improves maneuverability and stability, they also greatly enhance one's sensory experience, allowing swimmers and divers to interact with our waters, exploring the world below the waves through optical instruments that mimic properties of many aquatic beings. Once human flight was attained, advances in aircraft technology resulted in capabilities far surpassing those of any other living creature[7] (Bar-Cohen, 2006). In his essay "Mother Nature

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again, the cell's 'scouting' complex recognizes it immediately, and Cas9 quickly destroys the viral DNA to prevent further infection. Before this discovery, altering the genes in a cell was a challenging and time-consuming business, considered by many to be impossible (for more details, see Jinek et al., 2012; Fernholm, 2020).

5 In 2020, they won the Nobel Prize in Chemistry for pioneering the technology behind CRISPR-Cas9 genetic scissors. Setting the scientific world ablaze, this novel genetic tool revolutionized genetic research by enabling effective DNA manipulation in all organisms.

6 See C. J. Botham, *Parachutes : A Fantastic Dream of the Ancients Come True* (2023).

7 For more details, see https://bodysurfer.org/category/the-history-of/.

Got There First", Arthur C. Clarke remarked that "we never invent anything that nature hasn't tried out millions of years earlier" (Clarke, 2000, p. 333). Biomolecular tools which nature has perfected in bacteria, jellyfish and algae for millennia are now instrumental in the fields of medicine and biological research (Zimmer, 2021). From ancient myths and stories to the invention of mechanical automata and the advent of technologies like CRISPR, glowing proteins[8] and optogenetics,[9] humankind has increasingly turned to the natural world in the quest to enhance its capabilities.

Although nature has long served as a wellspring of inspiration and innovation for human ingenuity and experience, there is a noticeable gap in the realm of human augmentation through prosthetic means in terms of animal-inspired explorations. The astonishing advances in prosthetic devices that can replicate human form and functions such as bionic prosthetics and robotics, or miniature components that can stimulate nerve sensations, such as microchips[10] and magnetic beads,[11] are constrained by a predominantly human-centric stance on technologies that views them primarily as tools for advancing practical application. Their ever-improving functionality is

8 The original green fluorescent protein (GFP) was discovered in the early 1960s as a result of research on Aequorea victoria jellyfish, where it worked in conjunction with aequorin to produce a characteristically green luminescence. GFP has been used extensively for gene-expression tracking, offering various mutations and colors, and these are collectively known as fluorescent proteins (FPs). Scientists have used them for decades to track and map proteins in cells (Kremers et al., 2011).

9 Optogenetics was inspired by micro-organisms called archaea, specifically species like Natronomonas pharaonis and Halobacterium salinarum that feature light-sensitive ions. These light-sensitive proteins, known as microbial opsins, served as the basis for the development of optogenetics, a technique that allows researchers to control the activity of specific neurons using light. See the work by Ed Boyden at MIT https://www.media.mit.edu/articles/ed-boyden-and-optogenetics-the-future-of-neuroscience/

10 Scientists can now use electronic transmitter implants to stimulate nerve endings to actuate prosthetic limbs. In 2014, Ian Burkhart, a quadriplegic, became the first person to receive a microchip implant in his brain, allowing him to 're-animate' his right hand, wrist, and fingers. This groundbreaking procedure took place at Ohio State University's Wexner Medical Center. The tiny brain–computer interface (BCI), no larger than a grain of rice, records electrical signals from Burkhart's motor cortex, responsible for voluntary movement. These signals are then translated by machine-learning algorithms and sent to a flexible sleeve on his right forearm, which stimulates his muscles, enabling him to regain some movement in his paralyzed limb. This marked the first time someone's own body part was re-animated by means of a neural bypass using such technology (Geddes, 2016).

11 Researchers from Hugh Herr's Biomechatronics group at MIT have demonstrated that it is possible to achieve sensory feedback resembling the natural proprioceptive and cutaneous sensations that occur in a human body in prosthetics and bioengineered technologies. By inserting magnetic beads into AMI muscle to allow the bionic limb's computing software to more accurately track muscle contractions, and using a CMI (cutaneous mechanoneural interface) that links cutaneous (skin) nerves to the limb to replicate the sensation of touch, the researchers managed to restore sensory cutaneous feedback for amputations of varying etiologies and levels, from tactile sensations and proprioception to different types of vibration.

designed to lead us towards a more efficient or 'super'-humanity, neglecting their potential to dramatically reshape the realm of felt experiences, whether sensory, emotional and/or aesthetic. This gap is particularly evident when considering the emergence of a new type of wearable technology – supernumerary robotic limbs. From an extra pair of robotic arms attached to the waist or shoulder (e.g., Llorens-Bonilla et al., 2012; Shin et al., 2015) to an extra pair of legs (e.g., Parietti & Asada, 2016) and supernumerary robotic fingers (e.g., Wu & Asada, 2014; Makin et al., 2021), these externally crafted limbs expand the delicate tendrils of human mobility. By weaving an intricate web of augmentation into the new realms of bodily possibility, they expand human physicality and basic cognitive and bodily perceptions. But in contrast to their ancestors – the wings of Daedalus or the helmet of Hermes – these novel augmentations are also generally confined to design approaches that foreground the anthropomorphic.[12]

If drawing inspiration from nature's ingenious designs has consistently unveiled astonishing possibilities, why does the field of body augmentation remain fixated on mimicking *human* attributes?

Why not extend our bodies with non-anthropomorphic structures that might lead us beyond our human physicality, sensory experience, and even cognition? Why not transform our biological body representation and expression through animal-like body augmentations?

Imagine if embracing and (ab)using such alternative 'chimeric embodiments' – ones that we are not born with – were to radically challenge our functional and cognitive abilities and senses, thus charting alternate landscapes of sensation and subjectivity? And could these lead to heightened empathy, offering us a unique perspective on the experiences of those with varying bodily abilities, whether human or animal? I therefore propose an alternative to a strictly anthropomorphic approach, in the form of chimeric embodiment, that explores unconventional, evolving structures through hybrid human–artifact interaction. As a result of the study and emulation of animal-inspired methods, mechanisms and processes, these chimeric embodiments could blend and integrate human and animal-like morphologies and capabilities, leading us towards novel augmentative abilities and experiences. As human augmentation devices, as well as novel artistic tools, these animal-like devices could offer alternative evolutionary avenues that lead us beyond our human physicality and towards an exploration of radical, intimate and involuntary interfaces with the body. By challenging our understanding of human corporeality, I call for new, creative and explorative models of embodiment, ones that take their cue from the animal

12 The design principle currently highlighted in the development of substitution technologies.

realm to create artworks, designs and technologies that augment and challenge human performance, perception and experience beyond the familiar, conventional and accepted.

As I have already remarked in these pages, we live in an age where technologies are primarily seen as pragmatic tools.[13] This 'technical blockade"[14] view favors human uniqueness and autonomy. As a result, there have been very few studies looking at non-anthropomorphic and exploratory 'additional' contexts for augmenting the physical, physiological, sensory and cognitive capabilities, expressions and experience of the human body. Decentralizing the human with chimeric body augmentations directly threatens this integrity, thus disturbing the boundaries between humans, animals and machines. Human augmentation does not offer to serve solely utilitarian goals, it also acts as a mediator of human experiences (cognitive, somatic, hedonic, mental) and practices (Verbeek, 2016). It involves aesthetic engagement, situated creativity, core value, and the making of sense and experience (McCarthy, & Wright, 2004). Like the cheetah's legs rendering an animal-like limb as an artistic object and a device to confer super-abilities,[15] these non-anthropomorphic appendages can embody a transgressive materiality in which humanness' is neither a necessary nor the sole condition in attaining corporeal and technological harmony and unity. By challenging strictly anthropomorphic aesthetics through animal-inspired investigations, we can augment not only human appearance, cognition and expression, but also alter our deeply ingrained and conflicting standpoints, traditional notions of kinship, and established systems of values.

Just like the artificers of automata, who did not produce devices with utilitarian purpose but who nonetheless opened up worlds of new knowledge, experience and mechanical advance, we should, as Francis Bacon said, create and hunt by scent. It's only when we've taken "unexpected turns and changes" and ventured "off the beaten paths" that we can simulate our minds and explore the unknown

13 Where the pursuit of human satisfaction and success is marked by economic growth and practical benefits of technological advances (Gillen, 2021). The real efficiency of technology is therefore seen as a result of its capacity to advance human utilitarian-directed capabilities and bring economic progress.

14 The term 'technical blockade' implies that technical issues or challenges are hindering human progress. It implies that technologies' main function is that of linear progress, which leads to economic progress. The blockade is therefore a belief that 'something' blocked or prevented an ancient society in progressing technologies toward economic growth. That 'something' technology comprises spectacular and explorative devices – for more details, see the section 'The Shock of the New' (pp. 59).

15 Like the 'Flex-Foot' Cheetah Blades mentioned previously.

(Bacon, 1627/1983, p. 116; p. 306), revealing dimensions that may otherwise have gone unheeded. I therefore argue for an embracing of the unexpected – transforming the unknown to the known, and known to unknown – that can lead us beyond the limits of presupposed visual and conceptual possibility and into the uncharted, and perhaps unknowable, waters of unconventional invention.

Chimeric appendages, or what I prefer to call 'chimeric embodiments', devoid of anthropomorphic qualities, can therefore unlock a new realm of bodily and mental possibilities that can defy convention, opening room for unforeseen revelations, fortuity and surprise. Without the need to substitute a lost or lacking ability with the same function nor to enhance a previously inborn one, they are not bound to a human-like appearance. Such freedom to implement novel concepts can generate entirely new imaginaries of technologically enabling and enabled humans. By falling outside the range of 'accepted' and 'expected' corporeal possibility, they can lead us towards transcendent experiences, forging alternate ingenuities and novel ways of perceiving the world. Situated on the borders between mind and body, rational and subconscious, human and non-human, these chimeric embodiments therefore ask *you* to imagine the possible patterns of somatic and mental experience to come. More broadly, I believe that they can help us seek out a new role for human augmentation, where these embodiments act as catalysts for reconfiguring the discourses around technological advance, and as socio-political devices that can explore and imagine futures.

The transformative amalgamation of these chimeric-embodiments gives birth to the Chimera creatures, unveiling and shaping new realms of possibility and the future of human ingenuity.

Everything Comes Full Circle

The Chimera continues to be a compelling force in the realm of societal, cultural and scientific imaginations. Persisting across time – the past, the present and into the future – it is an ultimate and invincible being, migrating between worlds, spaces, times and disciplines. As both imaginary and real, Chimera is a creature of awe, wonder, potential and boundless possibility, leading us to stray towards the alternative avenues of bodily, mental and social structures. It is also a creature of fright and unease, due to its tangible and material ability to translate the imaginary constructs into the real and lived experiences through the use of advanced technologies.

In my work and research, I use the term *Chimera* or *chimeric* (as in 'chimeric embodiments') to describe this creature born from the fusing of human, animal and technological. A composite of various parts and features from a myriad species, entities, disciplines and techniques (including scientific, artistic, political and more), *Chimera* for me carries a multifaceted connotation, showing its name and nature to be the ultimate hybrid of them all. Through practices, techniques, technologies and appendages that accumulate around it, I see the Chimera as a raw material that wavers in a constant and dialectical tension – as both subject and instrument. As an arena of socio-political debate and scientific regulation, the Chimera reclaims the body as a site of resistance.

Viewed through this lens, my own Chimeric works represent this entanglement of artificial and organic entities with scientific and artistic disciplines, which – sometimes harmoniously, sometimes fractiously – converge and operate in unison while integrating into and onto a 'foreign' body. These chimeric embodiments thus engage in an anxious interplay between subject and object, serving as malleable subjects sculpted and manipulated by their creator, while simultaneously acting as objects of transformation that augment and alter the originary organic body. Through these interrelationships, they call attention to the ambiguity of body mutations as both interiorized by human subjects and externalized as discrete objects of aesthetic and scientific contemplation. The outcome of this fusion and amalgamation – uniting art

and science, biology and technology, observer and observed, subject and object, laboratory and studio – can yield unconventional perspectives and unearth discoveries that might otherwise have been deemed impossible. Therefore, I perceive Chimera as both an epistemic and a collaborative entity, and Chimeric practice as simultaneously in-formative, trans-formative, and per-formative, inviting explorations of uncharted paths and innovative methods for perceiving the world.

In *Minima Moralia,* Theodor Adorno said that "behind every work of art lies an uncommitted crime" (Adorno, p. 111). My Chimera creations, in this context, perpetrate this act repeatedly. They are creatures of resistance, trying to incite both reaction and action, guiding us from a state of bewildered wonder, then a fear generated by an apprehension of the eerie or uncanny, and ultimately towards what Bernard Andrieu calls a "definition of a new world" (Andrieu, 2016, p. 5), a journey into an alternate evolution, reality, and understanding. At the same time both imaginary and real, monstrous and wondrous, human and non-human, organic and inorganic, normal and abnormal, they are exceptions to the ordinary, the well-known, the conventional order of things. Thus my use of Chimera is related – in a general sense – to the disrupting, making and remaking of knowledge, techniques, practices, perceptions and artifacts, as well as to the search for new ways of being, seeing, knowing, doing and experiencing. It is a creature of alterity, of ambiguity, of the Other, of l'homme différent – the extraordinary, the unfamiliar, the disconcerting and the enigmatic. It is a being of boundless possibilities, not to be denied, ignored or overcome, but to be acknowledged, embraced and explored. Chimera is the transgression I myself willingly embrace.

Chimera bears two distinct connotations. In one it embodies the excitement of collaboration, where diverse elements harmoniously unite. In the other, it pertains to the power of imagination, where ideas and fantasies materialize into transformative existence. These parallel definitions, one of construction and the other of creativity, correspond to the realms of science and art respectively. They are the crucibles in which components are assembled and alchemized, and visionary vehicles for embracing future possibilities. As Brenda Laurel suggests, "both have the capacity to represent actions and situations… in ways that invite us to extend our minds, feelings, and sensations" (Laurel, 1991, p. 32). Both art and science are perpetually moving acts, eternally (co-)evolving by forging innovative and intimate ideas into tangible forms. "Transforming the state of reverie to that of execution" (Bachelard, 2005), they are the adaptive and powerful processes that weave our future on the loom of innovative thinking. As an integral part of both scientific and artistic fantasies, and my own *chimeric* practice, Chimera is unavoidably incomplete, serving as the foundation for future creations whose subsequent iterations in turn have the potential to expand

endlessly. The Chimera hence stands before us as a contradictory and ever-evolving entity that charts an infinite landscape of exploration as it engenders alternate, intimate and sometimes involuntary interfaces with the body. In her presence we are reminded of the unpredictable, the unknown, and the boundless possibilities inherent in our very ontology.

Dante once wrote that as human beings we are all in different states of transition, travelers in the ever-changing world, "not formed to live like brutes but to follow virtue and knowledge" (*Inferno 26*, as cited in Kenneally, 1995, p. 111). I firmly believe that only through radically reimagining bodies, minds, and their practices, will we end up having substantially different thoughts, experiences, and philosophies.

In seeking for the future of the alternate and fluid human object, I propose a new and radical Chimeric version of the human subject.

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Projects-Photo Credits

Ana Rajčević, *Faceless*, 2013
p.24
Chimeric-embodiment and the Subject: Ana Rajcevic
Photography: Clinton Hayden, Ana Rajcevic

Ana Rajčević, *Taurus,* 2015-2016
pp. 32
Chimeric-embodiment: Ana Rajcevic
Subject: Otti Raynolds
Photography: Ana Rajcevic
Lighting assistance: Achilleas Gatsopoulos

Ana Rajčević, *Animal: The Other Side of Evolution,* 2012
pp.38
Chimeric-embodiment: Ana Rajcevic
Subject: Anna Tatton
Photography: Ana Rajcevic, Fernando Lessa
Awards: *Best Design Award, 2012*, University of the Arts London, UK; *Project of the Year Award 2012*, International Talent Support (ITS), Trieste, IT
Award Nominations: *Outstanding Creation & Innovation Prize 2014*, International Art and Design Biennale, Saint-Étienne, FR

Ana Rajčević, *Second Surface*, 2013-2014
pp. 48
Chimeric-embodiment: Ana Rajcevic
Photography: Baker & Evans
Geometry: Kristoffer Josefsson, former (Fosters + Partners)
Computer-Aided Design: Luciano Letteriello (Zaha Hadid Architects); Octav Pero (Dominique Perrault Architecture)
Rapid Prototyping Advisor: Gregor Anderson (Fosters + Partners)
Award Nomination: *Artist of the Year 2014*, Global British Awards, London, UK

Ana Rajčević & Marco Donnaruma, *Amygdala: MK2,* 2017
pp. 56
Chimeric-embodiment: Ana Rajcevic
Research, concept, photography: Ana Rajcevic, Marco Donnarumma
Programming and computational art: Prof. Alberto de Campo (University of the

Arts, UDK, Berlin), Marco Donnarumma
Scientific partners: Neurorobotics Research Laboratory, Berlin, DE; Baltan Laboratories, Eindhoven, NL

Ana Rajčević & Marco Donnaruma, *Amygdala: MK3*, 2018
pp. 64
Chimeric-embodiment: Ana Rajcevic
Research, concept, photography: Ana Rajcevic, Marco Donnarumma
Programming and computational art: Prof. Alberto de Campo (University of the Arts, UDK, Berlin), Marco Donnarumma
Computer-Aided Design: Christian Schmidts (University of the Arts, UDK, Berlin)
Scientific partners: Neurorobotics Research Laboratory, Berlin, DE; Baltan Laboratories, Eindhoven, NL
Awards: *Art and Science Yearly Prize 2018*, German Federal Ministry for Education and Research and Wissenschaft in Dialog, DE; *Magic Machine Award 2021*, RosyDX, C. Rockefeller Center, Netzwerk Medien Kunst und Technische Sammlungen Dresden, DE
Award Nomination: *Best Project 2018,* Ars Electronica Festival, Linz, AT; *Innovation Award 2018,* Share Prize, Turin, IT

Ana Rajčević & Marco Donnaruma, *Rei,* 2019
pp. 72; 78
Chimeric-embodiment: Ana Rajcevic
Subject: Marco Donnarumma
Programming and computational art: Prof. Alberto de Campo (University of the Arts, UDK, Berlin)
Computer-Aided Design: Christian Schmidts (University of the Arts, UDK, Berlin)
Scientific partners: Neurorobotics Research Laboratory, Berlin, DE; Baltan Laboratories, Eindhoven, NL; CTM Festival, Berlin, DE
Photography: Cosimo Trimboli, Manuel Vason

Ana Rajčević *Educell Laboratory*, Ljubljana Slovenia, 2023
pp. 90
Photography: Sandra Sajovic

Ana Rajčević, *The Cell,* 2023
pp. 96; 104-106
Scientific partners: Educell company for cellular biology, d.o.o., Ljubljana, SL

Production and cooperation: Kapelica Gallery - Kersnikova Institute, Ljubljana, SL
Scientist help: Dr. Ariana Barlič
Expert help: Kristijan Tkalec
Supported by Kons Platform, SL
Photography: Ana Rajcevic, Sandra Sajovic

Ana Rajčević, *The Lizard,* 2023
pp. 116
Credit: The Author

Ana Rajčević, *C,* 2019-2020
pp. 124
Chimeric-embodiment: Ana Rajcevic
Subject: Marco Donnarumma
Programming and computational art: Prof. Alberto de Campo (University of the Arts, UDK, Berlin)
Computer-Aided Design: Christian Schmidts (University of the Arts, UDK, Berlin)
Scientific partners: Neurorobotics Research Laboratory, Berlin, DE; Baltan Laboratories, Eindhoven, NL; CTM Festival, Berlin, DE
Photography: Dario J Laganà

Ana Rajčević, *Mechanical Bloom*, 2022
pp. 132;134
Chimeric-embodiment: Ana Rajcevic
Main collaborators: Adrienne Hart (Neon Dance); Hemma Philamore (Bristol Robotics Lab, University of Bristol)
Robotics: Alix Partridge, Calum Gillespie (Bristol Robotics Lab, University of Bristol)
Computer-Aided Design*:* Charlie Hope, Star Holdon
Photography: Ana Rajcevic,

Additional Material
Ana Rajcevic