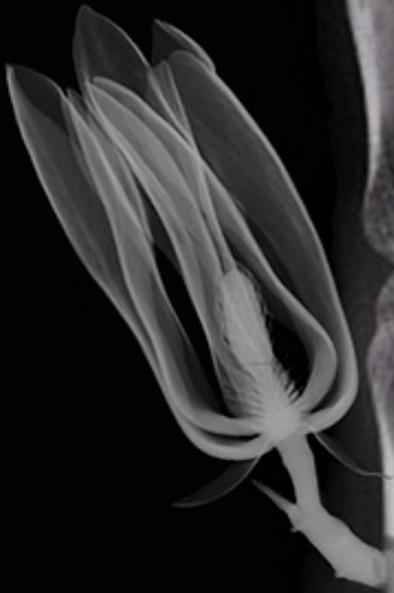


# BOTANICAL BODIES

If a tree could become a bone and a bone a tree,  
a potential symbiosis story



Marie Declerfayt  
2019

# **BOTANICAL BODIES**

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# INTRODUCTION

Botanical Bodies investigates the possibility to use plants as a raw material for the creation of human compatible organs. Progress in understanding the core of living organisms makes it possible to engineer the alive, making hybridation between species a designed process. It might as well be a necessity, in an attempt to preserve ecosystems endangered by the increase of human activities.

Whereas the post-human is usually imagined as a cyborg, blend of organic and digital, the possibility to merge to the vegetal world appears as a potential considering recent scientific developments. What if the man of the future becomes more plant than robot, more connected to his environment than taking advantage of it, more prone to merge back in relation to other life forms than stand out?

Using bones and wood almost as a case study for this possible blend, Botanical Bodies explores the possibility to turn this symbiosis with the vegetal kingdom into a process that one can choose to go through, where bones are the medium for this hybridation. From the extraction of the bone out the tree to the implantation, the gap between humans and plants, crowds and forests, bone and wood fade away.

# THE VEGETAL CYBORG

The augmentation of man-kind is a triggering potential coming to reality. Increase of existing capacities, repair of damaged tissues or acquisition of new skills, the possibility to enhance the human body opens the door to all kind of fantasies. The transhuman is often imagined as a cyborg, blend of organic and digital or mechanical parts.

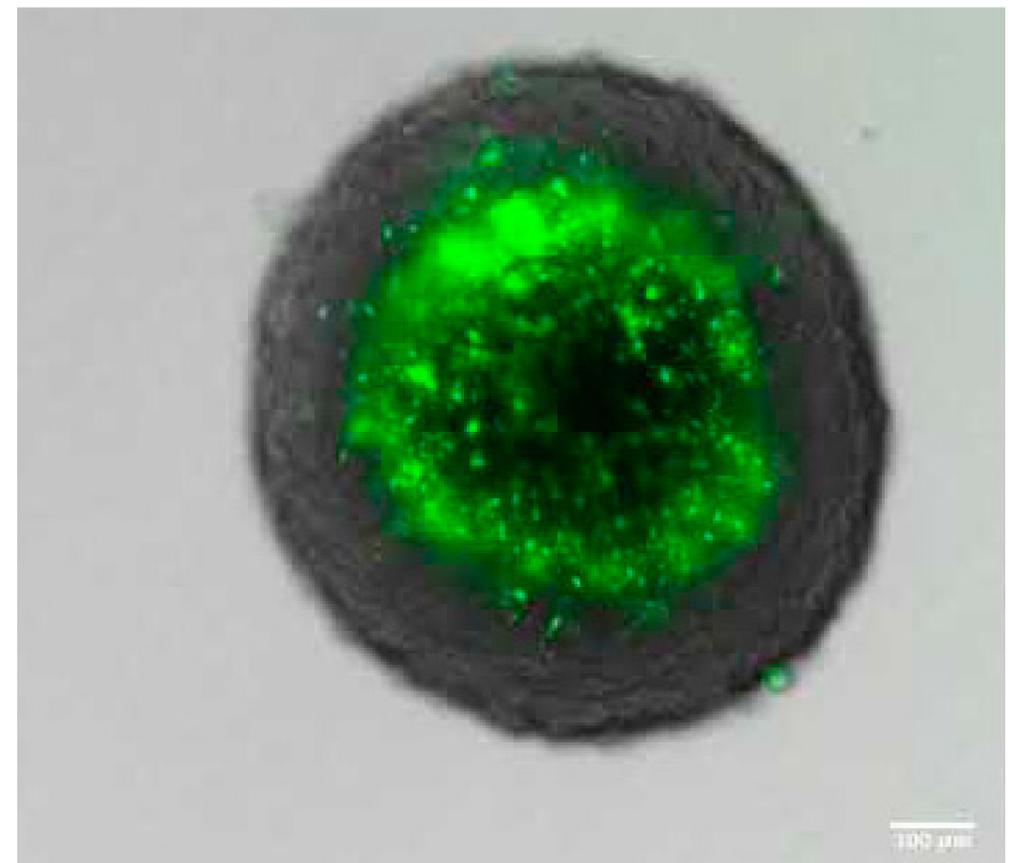
If this direction turns out to become reality (chip implantation, mechanical heart...), other possibilities to enhance the human body are currently being researched. The progress in the field of synthetic biology (design and construction of new biological entities) makes it possible to imagine new ways to modify the human body. The alive (from a bacteria to a plant) is something that can be engineered to gain new functions and serve designed purposes. What if the man of the future would be augmented not through the digital but through the vegetal?

*Cyborg : A cybernetic organism or "cyborg" in IT is defined as an organism with both biological and technological components. In some definitions, a cyborg is described as a hypothetical or fictional creation. However, in a technical sense, humans can be seen as cyborgs in various types of situations, including the use of artificial implants.*

*Transhuman : Transhumanism is the idea that the capability of the human species can be enhanced using technology. It is the idea that by adding non-biological components to a biological system, the human body, future societies will get quantifiable results in human ability and potential. Cyborg : A person whose physiological functioning is aided by or dependent upon a mechanical or electronic device.*

TOP : Abiocor total artificial heart implantable pump module, AbioMed, 2001

BOTTOM : Engineered bacteria (green) invade a tumor spheroid in a dish, Tetsuhiro Harimoto/Columbia Engineering



# DECELLULARIZATION AND BIO-ENGINEERING

*Decellularization is the process used in biomedical engineering to isolate the extracellular matrix (ECM) of a tissue (here extracted from a plant) from its inhabiting cells, leaving an ECM scaffold of the original tissue, which can be used in artificial organ and tissue regeneration.*

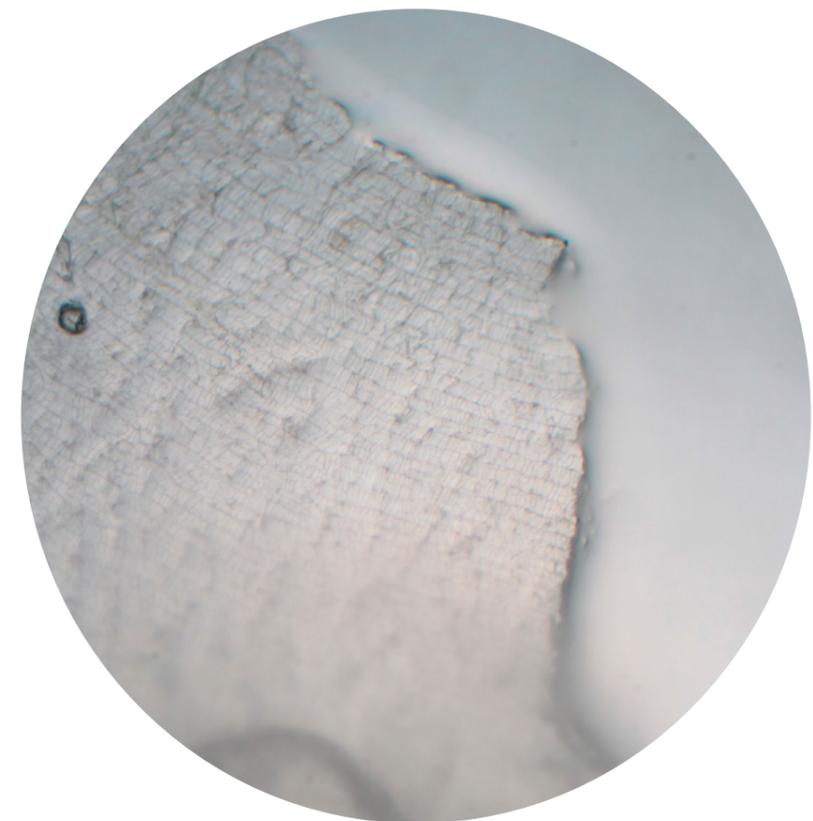
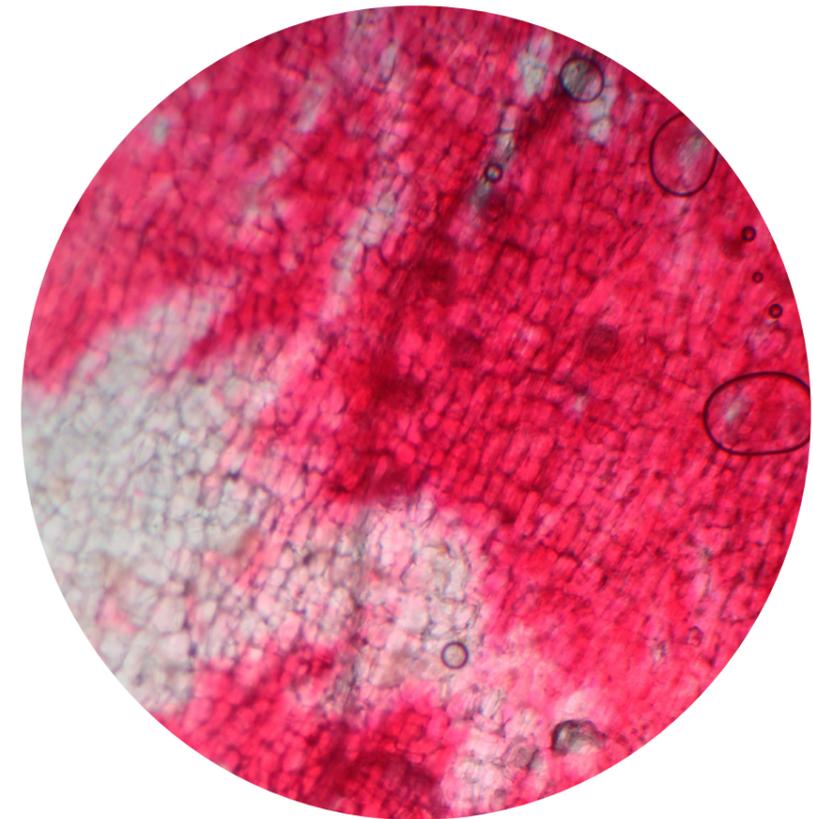
This technique has been used by several teams of scientists around the world to study the compatibility of plant-derived scaffolds into the body (Apple Derived Cellulose Scaffolds for 3D Mammalian Cell Culture, 2014, Modulevsky-Lefebvre-Pelling, University of Ottawa) and the advantage using them would bring, rather than engineering the scaffolds from scratch (Crossing Kingdoms: Using decellularized plants as perfusable tissue engineering scaffolds, 2017, Gershlak,-Hernandez-Fontana, Worcester Polytechnic Institute)

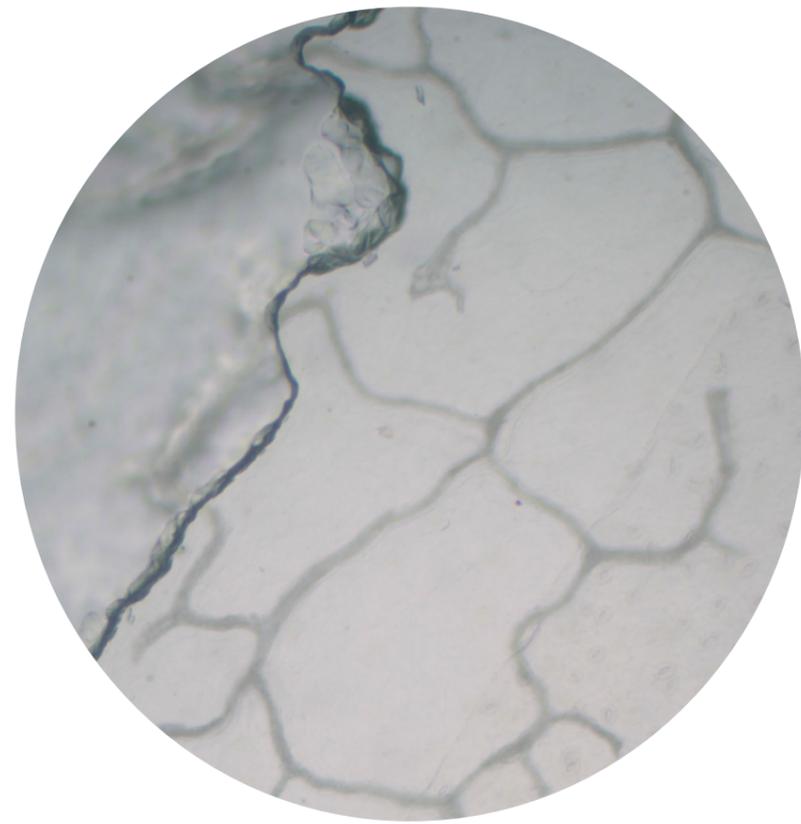
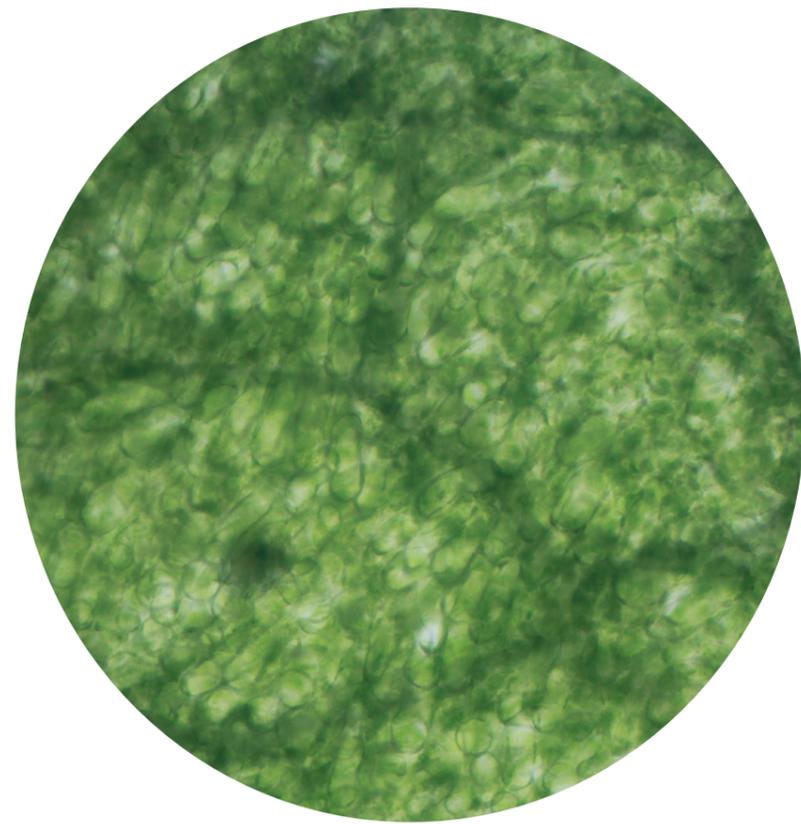
I started my research studying the reaction of plants (mainly fruits and vegetables) to this decellularization process, their change in aspect, shape, from an aesthetic point of view and trying to speculatively match each vegetable with an organ, questioning the effects this thought exercise had on me.

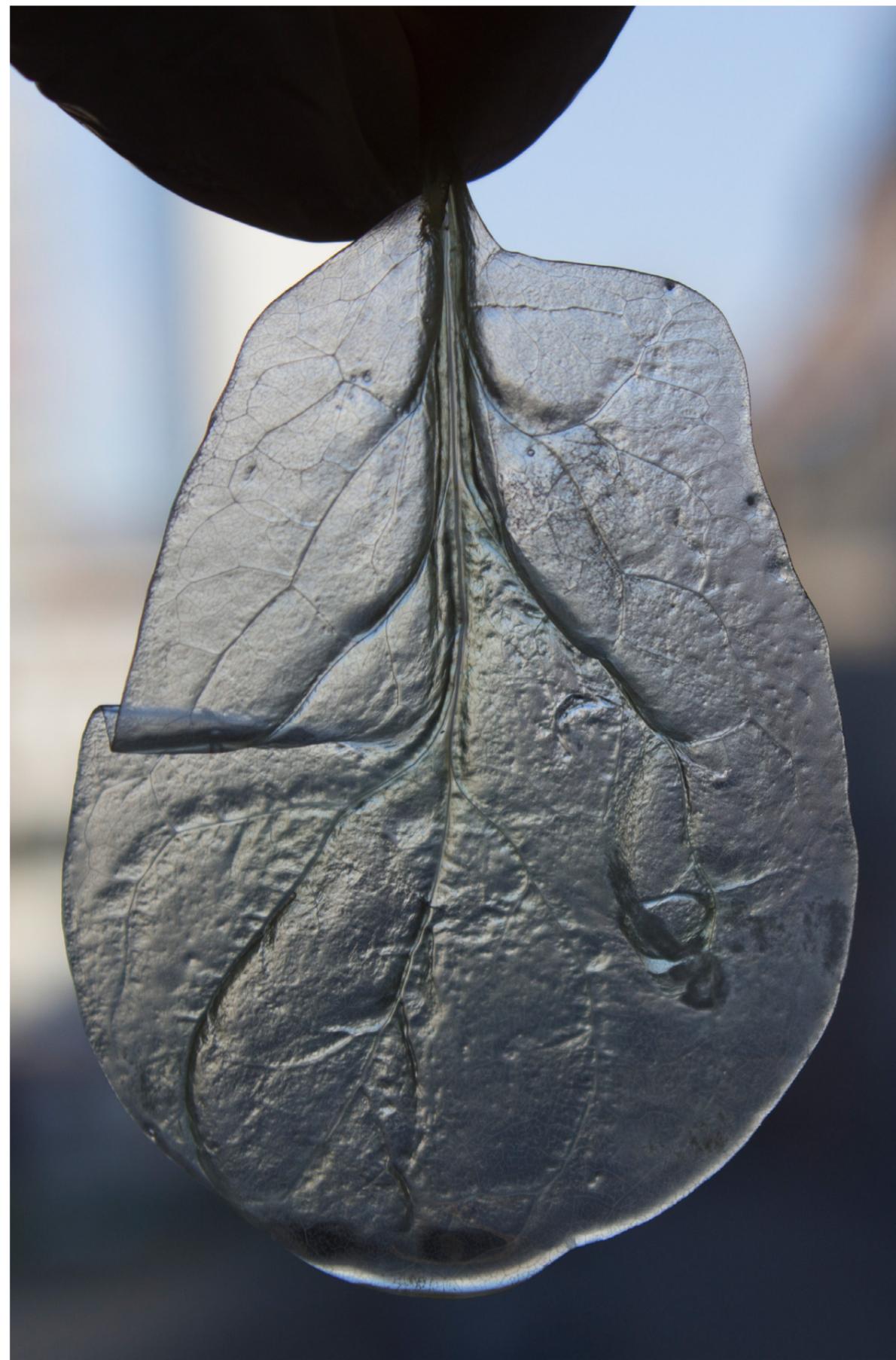
FOLLOWING PAGES: Microscopic observation of the decellularized samples (x10/ X40) Top : native sample, bottom: decellularized sample. Radish / Asparagus / Spinach

Spinach leaf 1 day in the decellularization process (SDS, Pelling method)

Spinach leaf, 9 days in the decellularization process (SDS, Pelling method)







# STRUCTURE SIMILARITIES

What if we could create implantable bones out of wood?  
What if it would be possible to engineer trees to produce the shapes that we need to replace damaged bones? What about harvesting bones in a new kind of forest?

Before considering the enhancement of the body, the first thing to consider is how it is possible to repair damaged organs. A group of scientists from the University of Bologna researched the conversion of wood into bone tissue (From Wood to bone: multi-step process to convert wood hierarchical structures into scaffolds for bone tissue engineering) Since the micro structure of wood presents characteristics comparable to the one of bones, they studied how with pressure, heat and injection of different chemicals (phosphate and calcium), rattan wood can be made into a matter similar in mechanical properties to wood.

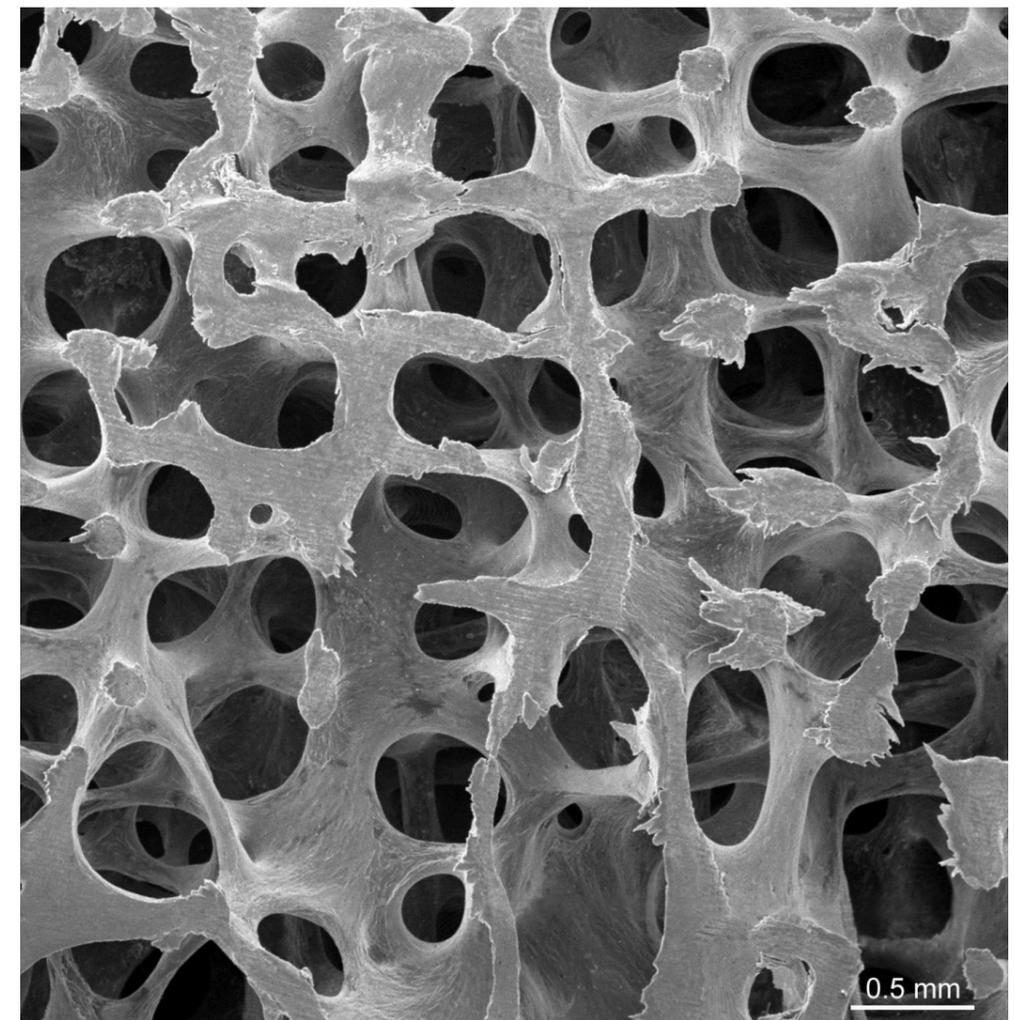
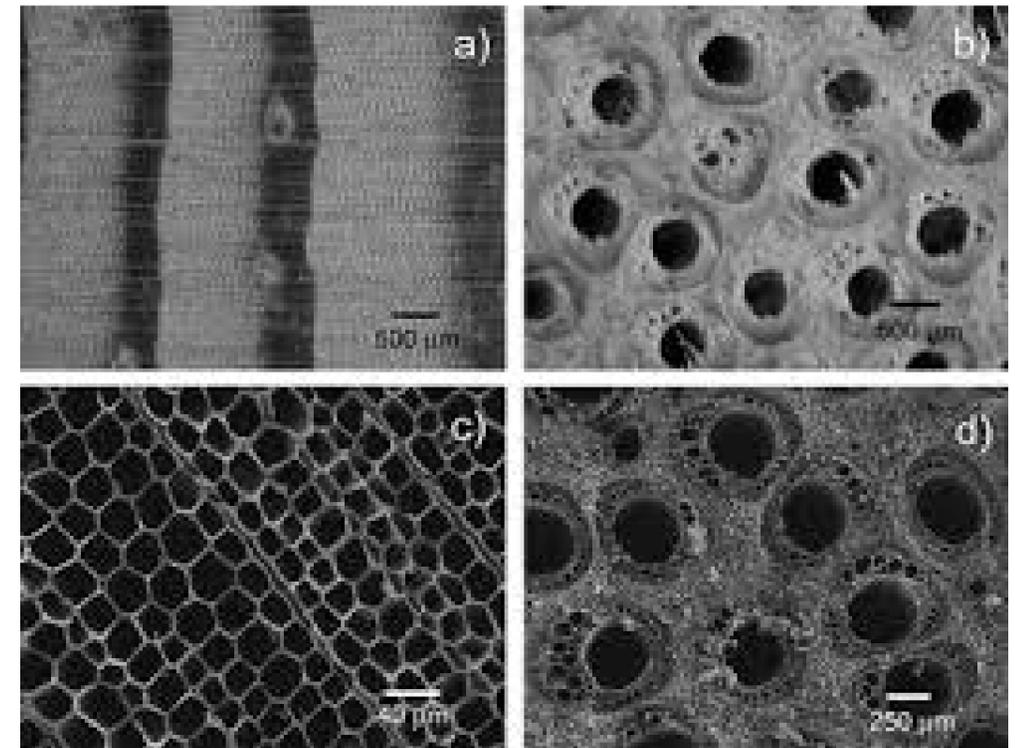
*“Showcasing research from the Institute of Science and Technology for Ceramics - Italian National Research Council, Faenza, and the Laboratory of Environmental and Biological Structural Chemistry (LEBSC), University of Bologna Title: From wood to bone: multi-step process to convert wood hierarchical structures into biomimetic hydroxyapatite scaffolds for bone tissue engineering*

*The remarkable features of natural bio-structures depend on their hierarchic structure which is an organized assembly of structural units at increasing size levels. It follows the primary importance of developing breakthrough processes to transform plant-derived hierarchical structures into biomedical devices for bone substitution and regeneration with smart anisotropic performances.”*

*From Wood to bone: multi-step process to convert wood hierarchical structures into scaffolds for bone tissue engineering, Abstract*

TOP: SEM images of wood in its native form and after pyrolysis, native pine wood, native rattan wood (a-b), pyrolysed pine wood, pyrolysed rattan wood (c-d) From Wood to bone

BOTTOM: SEM of young (22-year old), male human bone



## THE FEELING OF WOOD

Wood, a material we are extremely familiar with is transformed through this process in bone matter. What are the implications of this transformation? What does it mean to be able to replace once bones with wooden ones?

We are all intimately familiar with our own bones in their shapes, the movements they allow, the structure they create but we don't visually see them as a material in the way we perceive skin for example. Being able to replace actual bones with wooden bones creates a bridge between our inner organs and a matter that is familiar in its texture, warmth, weight. It would allow us to become more aware of our own skeletal system by filling the gap there is between seeing a replica of a bone and being aware that it functions within the body. Where metal can be used to repair bones, it always acts as a support and doesn't blend into the body. The wooden bones created here seems to be accepted by the body and merge into the existing tissues.



TOP: Clavicle angulated fracture, plate repair

RIGHT: Poplar clavicle

## THE PERCEIVED AUTONOMY OF THE BODY

The idea that in a close future we will be able to repair once bones with wooden bones is getting further if we consider wood not as a dead material that doesn't evolve but as what it is in term of where it comes from: an organic, evolving, growing matter extracted from a tree. The idea is then not anymore about wooden bones but tree bones. Then entering another perspective: the possibility of becoming a chimera with a plant. Being able to get a tree transplantation is going way further than a wood transplantation: it is questioning the identity of the human body, as an individual being and as part of a specie.

Acknowledging that the human body is not an autonomous machine, but is fundamentally interconnected to its environment is the first step to consider a conscious and chosen assembly with the vegetal world.

*We are now beginning to realize that "individuals" aren't particularly individual at all. The organisms of development biology, along with Darwin's species, all turn out to be complex assemblages, typically made up of more cells of others than of their "own".*

*The imagined autonomy of the individual was tied to the autonomy of the species. Each species was thought to rise or fall on its own merits, that is, through the fitness of the individuals it produced. Individuals were just one kind of self-containing unit that could be summed up or divided like building blocks, from genes to populations to species-and sometimes even to nations, religions, or civilizations. Today the autonomy of all these units has come under question, and each questions works to undermine the edifice built from the segregation of each from each. As biologist Scott Gilbert tells us, "we have never been individuals" His "we" refers to all life; his "individuals" are autonomous species as well as single organisms. If most of the cells in the human body are microbes, which "individuals" are we? We can't segregate our species nor claim distinctive status-as a body, a genome, or an immune system. And what if evolution selects for relations among species rather than "individuals"?*

*Beyond individuals, Elaine Gan, Niels Budandt*

# THE MYTH OF THE MANDRAKE

The mandrake is one of the few historical representation of a plant with human qualities. Associated with danger and magical properties, the mystical properties of the mandrake appear in many cultures, from Persian to Chinese manuscripts (circa 13th century).

*There is no plant that embodies the encounter between humans and plants better than the mandrake, whose myth has the cosmic sense of a profound correlation between nature and humanity and the possibility of their merging." The Greeks used to call it anthropomorphos or mandragoras. According to legends and traditions, which have in fact been constantly elaborated over the centuries, the mandrake does not only look human: it can moan, scream, sob, speak and sing as well. Magicians and sorcerers even knew how to perfect its human form and make it look like a "little person".*

*The myth of the Mandrake, the "Plant-Human"*  
Thierry Zarcone

Michel Fournier in Friday, or, The Other Island (Vendredi ou les Limbes du Pacifique) depicts the slow fade of Robinson Crusoe toward the island, that he first tried to domesticate before merging into her.

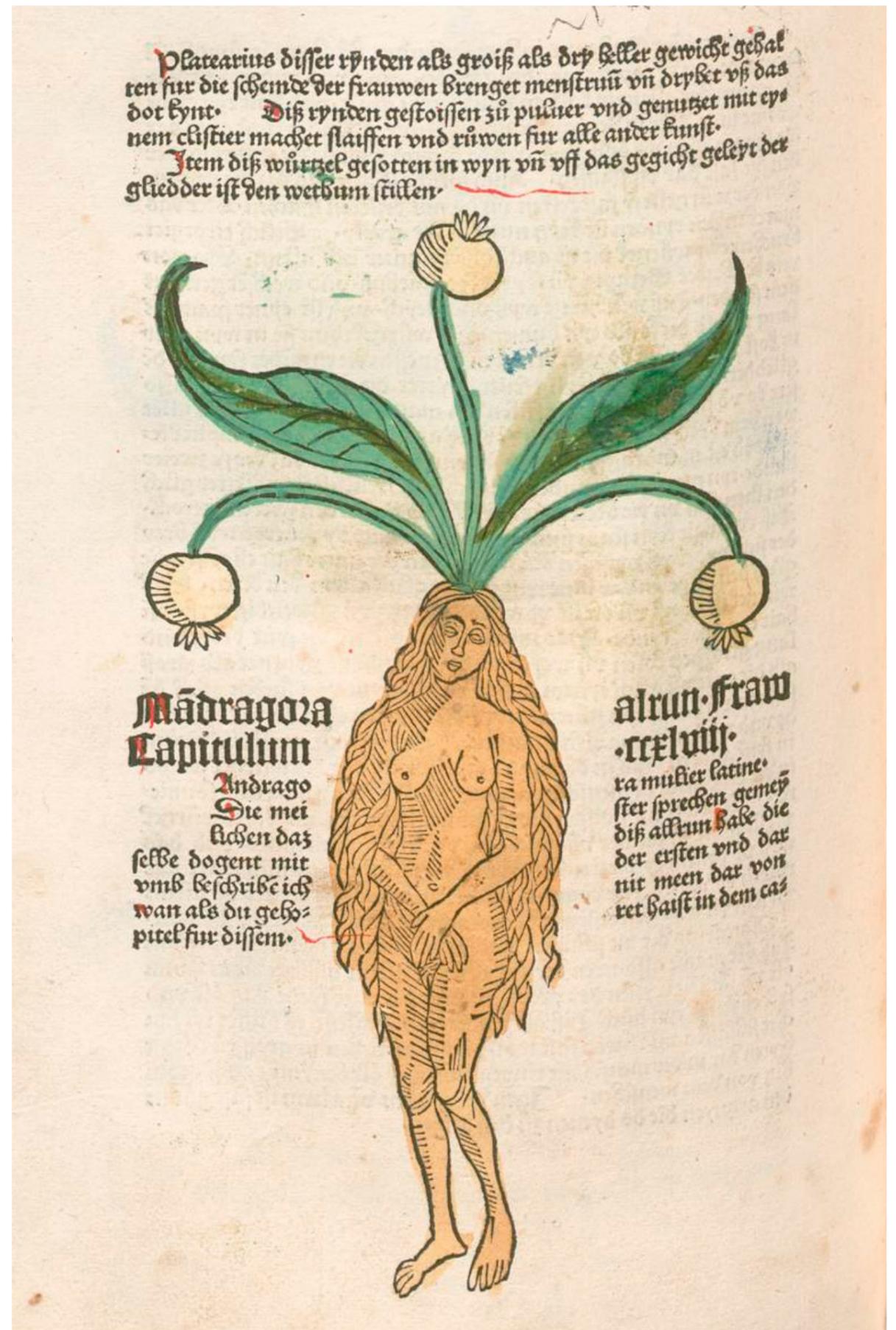
*His awareness was alerted by the proliferation of a new plant he had not seen anywhere else on the island. There were large serrated leaves growing in clumps at ground level on a very short stem. Robinson examined them with curiosity, then did not give them any further thought until the day when he thought he had indisputable proof that they regularly appeared in the exact spot where he had spilt his seed. Then his mind did not stop turning this mystery over and over. He buried his seed near the cave. In vain. Apparently only the coomb could produce that variety of plant. The strangeness of the plants stopped him picking them, cutting them up, tasting them, as he would have done in other circumstances. In the end he had looked for a variant to this pre-occupation with no solution and a verse from the Song of Songs, which he had repeated thousands of times without attaching any importance to it, brought him instant illumination: 'Mandrakes will perfume the air,' the young bride promised. Was it possible that Speranza [the name of the island] was keeping that Bible promise? He had heard tell of the marvels about the solanacea that grows at the foot of the gibbet, where hanged men have*

*spilt their last drops of seminal fluid, and which is in short the product of crossing man and earth. That day he rushed to the pink coomb and kneeling before one of the plants he very gently drew up its root by digging all round with both hands. It was true, his love union with Speranza had not been barren: without a doubt the fleshy white root, curiously forked, had the shape of a girl's body. He was trembling with emotion and tenderness as he replaced the mandrake in its hole and drew the sand around its stem, as you tuck a child up in bed. Then he stole away on tiptoe taking great care not to crush any others. Now, with the Bible's blessing, a stronger closer bond connected him to Speranza. He had humanized the one he could henceforth call his wife in an incomparably deeper way than all the governor's projects. Of course he suspected that on the other hand for him this closer union meant a further step towards shedding his own humanity, but he only realized its extent in the morning when he woke up to discover that his beard, as it grew during the night, had started to take root in the earth.*

*Michel Tournier, Vendredi ou les limbes du Pacifique*

NEXT PAGE LEFT: Medieval Herbarium, Mandrake, Late 12th c

NEXT PAGE RIGHT: Hortus Sanitaris, Mandrake, Mainz : Jacob Meydenbach, 23 June 1491.



# CHIMERAS AND MONSTERS

Hybrids between species, chimera and monsters are perceived as irrational and archaic. The classification and hierarchisation of the species starting in the 16th century meant creation of a separation between humans and non-humans. The individualization of the body as part of a separated specie creates a separation from the environment where it is more about taking advantage of other species than collaborating with them. Therefore we see tree as the mean to produce wood, used for heating, shelter, nourishment, but we are always separated from it.

This alienation of humans is currently challenged through the study of the monstrous aspects of life. It has never been autonomous, where one specie would be detached from other: for example, there are more foreign cells in the human body (microbes) than human cells. A specie is more characterized by its relations between other selves rather than by their properties as individuals.

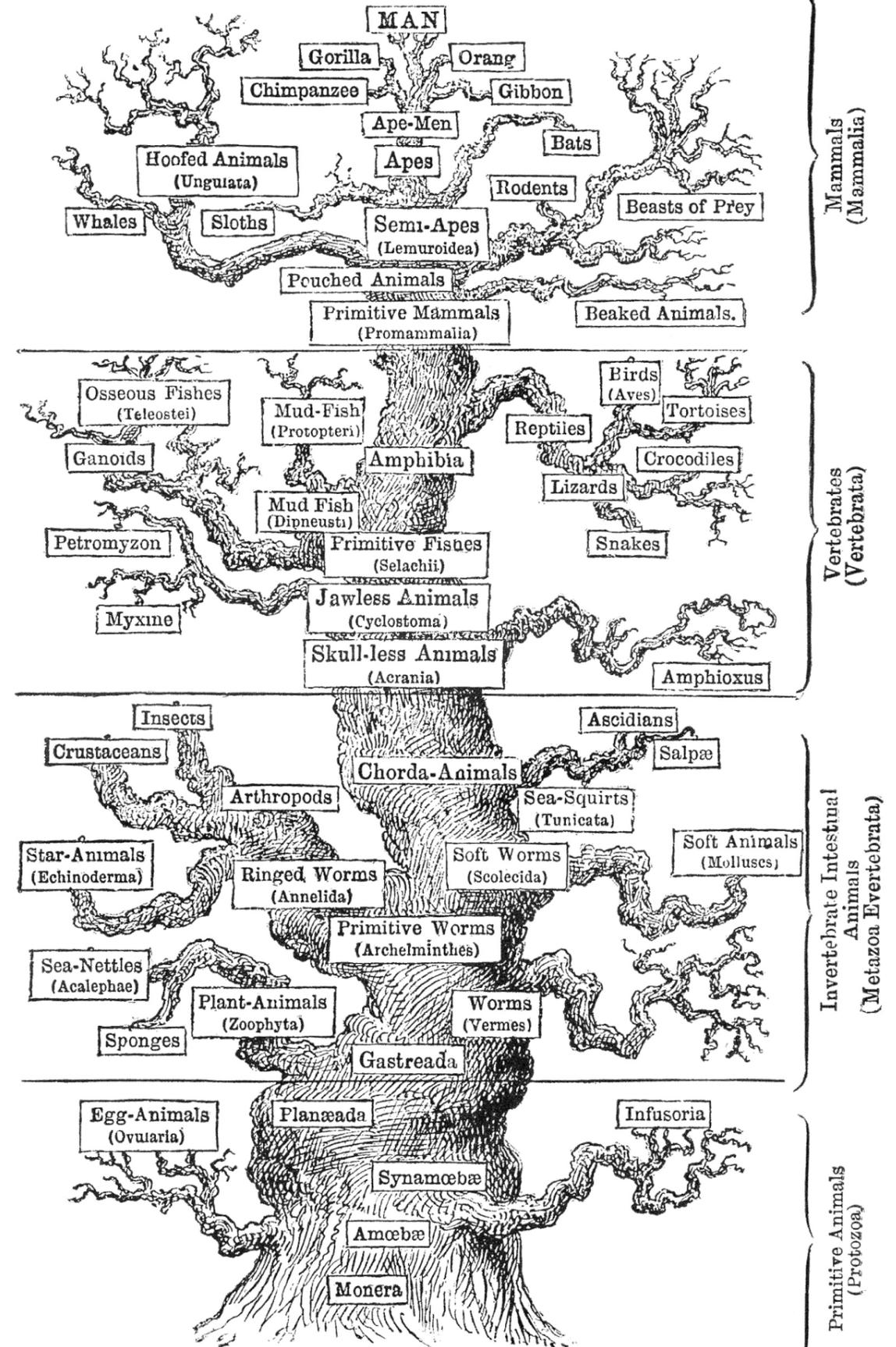
If it is the relation that matter more than the individual, what about engaging in a new relationship with the vegetal world by merging into it?

The perceived strict division between species is called into question when observing the amount of similarities between plants and mammals in term of microscopic structure. Plants and cardiac tissue follow the same patterns, bones and wood present structural similarities. All eukaryotes (including mold, fungi, plants and animals) evolve from prokaryotes, unicellular organism, whose cells do not have a distinct nucleus

*Life has been monstrous almost from its beginnings. In ancient times, prokaryotes (bacteria and archaea) gave birth to monsters in which one organism engulfed others or joined immoderate liaisons, forming nucleated cells and multicellular organisms called eukaryotes. Ever since, we have muddles along in our mixes and messes. All eukaryotic life is monstrous. Enlightenment Europe, however, tried to banish monsters. Monsters were identified with the irrational and the archaic. Category-crossing beings were abhorrent to Enlightenment ways of ordering the world. Later on, rationalization meant individualization, the creation of distinct and alienated individuals, human and non-human.*

*Bodies tumbled into Bodies  
Anna Lauwenhaupt*

PEDIGREE OF MAN.



## BONE FOR SYMBIOSIS

The choice of the bones for my study of a possible blend between the human body and the vegetal world is coming from their characteristics: they are the slowest renewing organs of the human body (10 years), which makes them the perfect vehicle to study this process : they already have similarities in pace. Why would such a hybridation the way I depict it (transplantation after transplantation, slowly merging into the vegetal world and becoming a new kind of chimera, blend of tree and organic) be desirable?

*Sym-poiesis is a simple word; it means "making-with". Nothing makes itself; nothing is really self-organizing. Sympoiesis is a word proper to complex, dynamic, responsive, situated, historical systems. It is a word for worlding. Sympoiesis for "collectively-producing systems that do not have self-defined spatial or temporal boundaries. Information and control are distributed among components. The systems are evolutionary and have the potential for surprising change."*

*We are compost, not posthuman; we inhabit the humusities, not the humanities. Philosophically and materially, I am a compostist, not a posthumanist. Being-human and not-become with each other, compose and decompose each other, in every scale and register of time and stuff in sympoietic tangling, in earthly worlding and unworlding.*

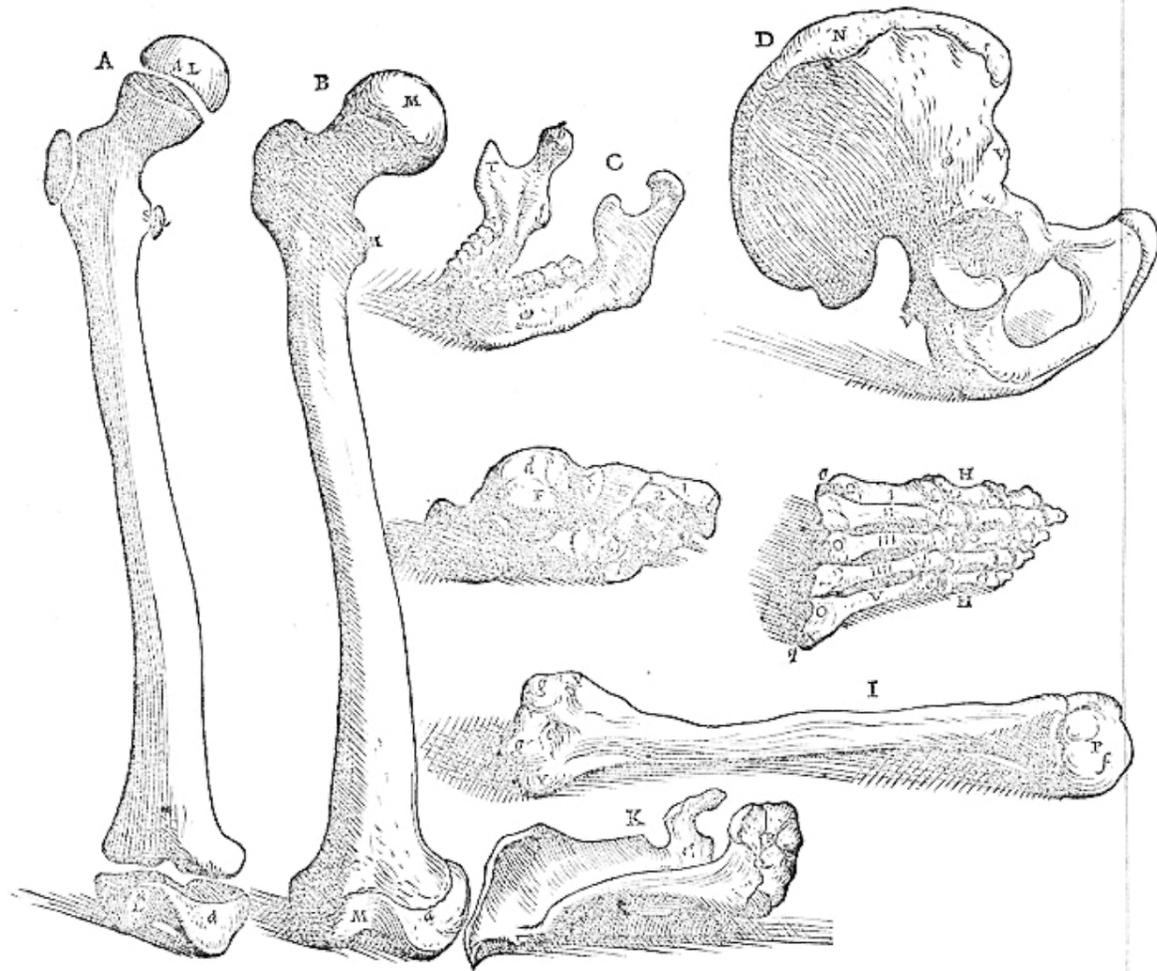
*Symbiogenesis, sympoiesis, and art science activisms for staying with the trouble. Donna Haraway*



TIBIA / FIBULA POPLAR TREE  
GROWTH STAGE 5  
VUE POSTERIEURE / LEFT  
SG45-26 [56 67]



NOMINA QUIBUS OSSIVM PARTES  
 sedesq; indicantur. Caput III.



PRAESENTIS TABVLAE EIVSDEMQUE  
 characterum index.

Proposita modo tabula aliquot ossi in hoc tantu delinantur, ut ossium partes & sedes, quarum nomina hoc Capite persequar, in nonnullis saltem ossibus apposite exprimant. Vnde si in huius Capitis contextu alicuius ossis hic non delineati mentio incidet, id ex figuris proprii sui Capitis, aut ex integris quae primi libri calci adhibebuntur, opportunè petes. Quanquam non



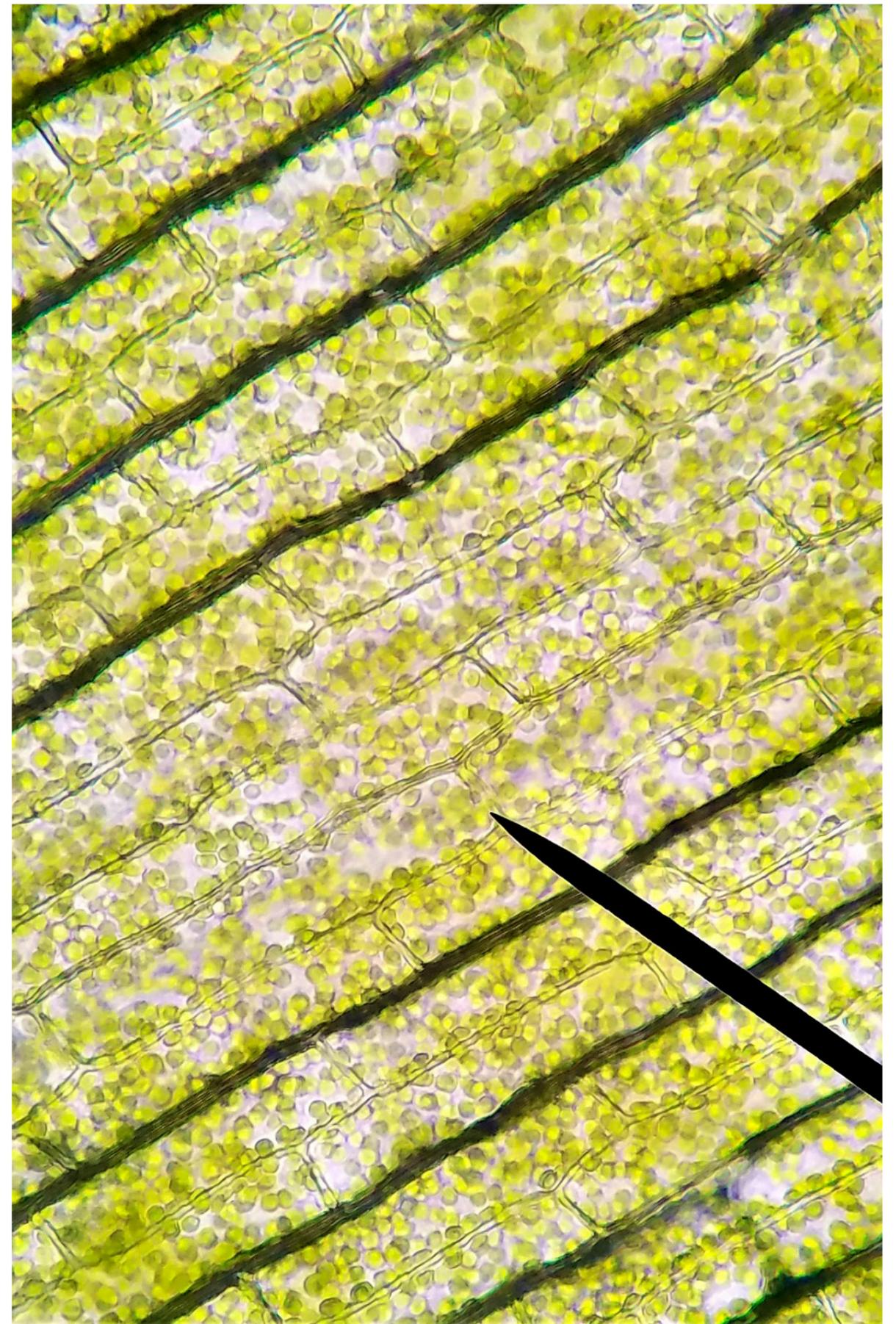
This broadening of human perception would allow an engagement with all kind of other species, in ecosystems endangered by the increase of blind human activities. As for plants (what would they have to gain if humans would feel more like them), even though it is impossible for us to perceive their needs and we might project on them in an anthropomorphic manner, maybe give them back the attention they deserve and bring closer a balance point the hierarchisation between the worlds: the vegetal world being passive and inferior and the mammal world active and as a result higher. Growing from a human body into a human tree would imply changes in perception and rhythm. Even if plants consciousness is impossible to relate to, some of the characteristics of the vegetal world could be a profitable asset.

*A fair amount of what we still know today, or what we think we know today, about plant life is laid out for us in Plato. Certainly for Plato plants are alive-they in fact have a soul, but they are the "lowest" form of the living: "passive", lacking any kind of communication, awareness or sensation. All this adds up to plant's well-established role in the West as the poorer cousins to animals, the lowest threshold of living things: stuff that lives solely to serve the other, "higher" beings. -[...] Research into "plant intelligence" over the past few decades however refutes all of this traditional picture of plant life : plant do in fact communicate with other plants; they evidence both aggressive and defensive behaviors; they feign certain states to fool predators or attract pollinators; and of course plants do move, only at a much slower time-scale than most animals; there is even research to suggest that plants feel pain, or at least respond decisively to extreme danger.*

*Jeffrey Nealon Plant theory-Biopower and Vegetable Life*

The idea that nature is not real anymore could signify a kind of regret for a golden age where nature means untouched. Centuries of breeding then seem to have destroyed this fantasized concept of a "pure" nature. The breeding of vegetal species to achieve production goals profoundly changed landscapes. Using breeding techniques to develop trees able to provide the right kind of wood (in term of structure, strength...) to create human compatible organs is one more step in this engineering of nature, but going toward a different direction: instead of only taking advantage of the resources of the plant, the hybridation would induce a new balance, closer to a zero-sum game.

RIGHT: Turgid elodea cells, under a microscop, x400



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EN - ATLAS FROM YELLOW POPLAR  
TREATED FOR HUMAN/VEGETAL HYBRIDATION.  
CONTAINS CELLULOSIC PHOSPHATE/CA  
PROGRESSIVE SYMBIOSIS THROUGH OSSEUS REPLACEMENT

DE - ATLAS VON TULPENBAUM  
BEHANDELT FÜR MENSCH/ PFLANZEN-MISCHUNG.  
ENTHÄLT CELLULOSEPHOSPHAT/CA  
PROGRESSIVE SYMBIOSE DURCH KNOCHENERSATZ

FR - ATLAS EN PEUPLIER  
TRAITÉ POUR L'HYBRIDATION HUMAINE/VÉGÉTALE.  
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Considering a more global scale, the engineering of everything, from the breeding of plants to the modification of their DNA to serve human driven purposes creates a global change in the functioning of ecosystems, endangering a fragile balance of relations between organisms. Using this engineering power to allow the blend between men and tree (from the modification of trees to be able to extract the bones to the acceptance of the wood material by the body, considered not as a threat for the organism but as something to thrive to) could be a way to bring back this balance: a more elegant exit for man-kind, slowly merging back into the vegetal world where it comes from.

