
Palgrave BioArt

Series Editor

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Reconfiguring living organisms into technologies can change our relationship with the environment, our bodies, and with concepts of materiality, nature, and life itself. What happens when we treat life as a raw material for artistic expressions? *Palgrave Studies in BioArt* presents a series of books written by researchers and artists who manipulate life in scientific laboratories. These artists develop new meanings relating to the concept of life through engaging, provoking, and creating contestable living and semi-living biological artworks. They ask: What is life? What is a body? What are the futures of life? And who is allowed to manipulate life? Such BioArtistic investigations are vital in articulating this new somatic-cultural space. The series will present important and diverse voices discussing frontier biotechnologies and their effects on society, ecology, industry, and life itself. This interdisciplinary series will be of interest to those working in the areas of art and design, science, cultural studies, bioethics, science fiction, and much more. We welcome proposals from researchers and practitioners in the field of BioArt, and cultural/experiential laboratory engagement.

Acknowledgments

We would like to acknowledge the contribution of all of *The Tissue Culture and Art Project* collaborators throughout the years and the many projects; Guy Ben-Ary, who joined the *Tissue Culture & Art Project* in 1999 and collaborated with us on the *Stone Age of Biology*, *Semi-Living Worry Dolls*, *Pig Wings*, *fish'n'chips* and *Disembodied Cuisine* until 2003 when he embarked on his own artistic journey; Stelarc for *Extra ear 1/4 Scale*; Bioteknica (Jennifer Willet and Jason Knight) for *Teratological Prototypes*, Marcus Canning for *NoArk 1*, Hideo Iwasaki for his support of *Victimless Leather* in Japan and in many other projects, Corrie VanSice for *The Mechanism of Life - After Stephane Leduc*, Robert Foster for *Better Dead than Dying* and other projects, Chris Salter for *Futile Labor* which also included Davon Ward who worked with us on *Vapour Meat/HPO.3.1]alpha* and different versions of the *Compostcubator* and Tarsh Bates for *Crossing Kingdoms*.

We would also like to thank Professor Miranda Grounds our forever mentor, and Professor Stuart Bunt who were both the co-founders of SymbioticA Laboratory. Special thanks to Professor Traian V. Chirilă who was the first to invite us into his laboratory to get the first wet lab experience. To Professor Stuart Hodgetts, SymbioticA scientific advisor and 'tissue culture guru', we hope to continue working with you into the future. Jane Coakley, Amanda Alderson and Chris Cobialis for their managerial and administrative support.

There is not enough space to acknowledge and thanks all the artists, scientists, humanities scholars, students and curators we worked with and shared personal and professional exchanges in the SymbioticA Laboratory. We hope to write about these experiences in a follow up book exploring the 22 years of SymbioticA.

Lastly, thank you Kelly Somers for editing this manuscript and for your insightful comments and suggestions.

This book builds upon and expands on previous published papers as well as original material. It is the first time, though, that our practice is narrated into a one book.

Introduction

This book is a story about how ideas regarding the concept of life need to be re-examined. It illustrates the complexity of human relationships with life in the laboratory and outside it, and above all about our uneasiness yet paradoxical joy in the hands-on exploration of the transformation of life into the object and subject of our artistic work. Life becomes a raw material which escapes full control and escapes being fully mechanized, both literally and conceptually; this is a story about the semi-living.

In 1996 we came up with a question that we are still pondering in this book: 'Can living tissue be used to make art?' This question took us on a journey into much uncharted terrain and opened up so many more questions, such as: What are biological bodies? What is this thing we call life? What is art? And are there limits to interfering with life and art?

Very early in our work, on 5 August 1997, we were invited to an interview on Australia's ABC Radio National Art show to talk, for the first time on radio, about our work. The idea that artists can work in the biological laboratory with the stuff of life was unheard of then. After a short chat, the host invited listeners to call in to comment and ask us questions. The first caller, an older man, introduced himself as a painter who uses watercolours to draw and paint birds. He questioned whether we were artists at all and accused us of engaging in unnatural activity; he might as well have said that we were dealing in the unhallowed arts. Pausing for a moment to reflect, we responded, somewhat cheekily, by saying that putting marks on a surface to make them look like birds seemed to us much less natural than working directly with living biological tissue and spending time and effort in keeping these tissues alive and propagating. It might sound like a flippant response, but for us it raised a profound issue at the core of our and many other artists' explorations.

This book, *Tissues, Cultures, Art*, is the first in the Palgrave Studies in BioArt series. It narrates our collaborative artistic practice from 1996 to

date. It reflects, through discussion of our artistic projects, on the dynamic and sometimes dramatic developments and changes that have happened to humans' understandings of and relationship to life and bodies. It explores how aesthetic intervention can craft different narratives of the joy and pain experienced by life and the often paradoxical nature of making sense of life while being alive.

This is our artistic and scholarly exploration of humans' changing relation to *life*, both as a material and as a concept, following the shift from the linguistic turn (e.g. Foucault and Derrida) to the new materialist school of thought (e.g. Braidotti and Grosz, to name only two) and its apparent limitations. In the ethos of the arts, we do not attempt in this book to resolve or to provide solutions or answers but rather to contest, problematize and deliberately provoke.

In a somewhat messy methodology, we narrate this book as a hybrid of personal reflections, poetics and anecdotes with a more rigorous, scholarly approach while mixing in visual representations of our artworks. These are poor relatives to the living, semi-living and dying artworks we have presented materially in different locations around the world, whether in scientific laboratories, art galleries and art fairs, science and natural history museums, public spaces, cafes or other strange places. These artworks, when presented in the flesh, we believe, have much more of their own stories to 'tell'.

Yet this is our humble and somewhat futile attempt to narrate post-anthropocentric stories, to explore whether a critical engagement with life (sciences) can be sustained in an increasingly neoliberal and capitalistic society which treats life as a technology and a resource to extract profit from. This book is being published in a pivotal time of human history, when notions of sentiency and agency usually associated with living systems are being transferred to technological ones. Furthermore, not only is sentiency being attributed to machinic bodies, it is literally and conceptually being

engineered out of the living in the quest for standardization, efficiency and automation. One of the questions we ask here is, is this the world we desire?

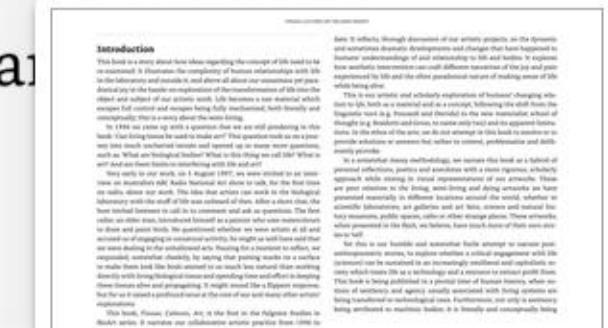
Tissues, Cultures, Art is concerned with our – humans’ – current psychopathologies of control, in particular when it comes to controlling life. One of the defining characteristics of *Homo sapiens* is that it modifies and manipulates its surroundings to fit its needs; its extended phenotype now reaches every corner of the Earth and further out into space. Life and living systems are not immune to this reach of humans. In other words, as human knowledge about life increases, so does the tendency to control and shape living things for human-centric wants and desires. Life is not only increasingly becoming a raw material to be engineered but, in new and complicated ways, manipulated living systems are being used as cultural objects and subjects. Artists, scientists, designers and engineers all play their part in this transformation of life itself. This creates a range of ontological conundrums and fantastical expectations as to what life could be and what life can do.

Following the experience and success of our Tissue Culture & Art Project back in 1996 (the story of which is narrated here), SymbioticA laboratory was founded in 2000. SymbioticA is the first research laboratory of its kind, enabling artists and researchers to engage in wet biology practices in a research-intensive university’s biological science department. With an emphasis on experiential practice, SymbioticA encourages better understanding and articulation of cultural ideas around scientific knowledge and informed critique of the ethical and cultural issues of life manipulation. The establishment of SymbioticA has encouraged the growth of BioArt laboratories and centres within and outside academia, many of which have been set up by residents of our laboratory. Given the historical scope of this institution and its influence on the field, we are dedicating a separate book in the Palgrave Studies in BioArt series to the story of SymbioticA. In addition, many of the follow-up books in this series are written by artists who were residents at SymbioticA laboratory and were mentored by us.

Living things exist as cultural objects in all human societies throughout history, as utilitarian as well as ritualistic and symbolic objects. Domestication shifted the power dynamics between humans and the nonhuman living world around us, resulting in anthropocentric aesthetic and emotional biases driving some of the selection pressures on domesticated organisms. It was only at the end of the twentieth century that artists started to experiment, in a serious yet playful way, with the manipulation of living biological systems, organisms and their parts. This may not be surprising, as humans’ perceived ability to manipulate living systems, from the molecular to the ecological level, has become systematic, more predictable, more reproducible and easier. It is important to qualify this assumption as this view is very short-sighted; in the long term, the cascading impacts of these newfound ways of manipulating life are nothing but messy, unpredictable and unreproducible. The complexity of life and its interaction with itself and the environment is still out of the grasp of the human ability to comprehend, let alone to control. The new ways of engineering life come in a time when human-made dry, hard and digital technologies are becoming more lifelike (e.g. ‘autonomous’ driverless cars and artificial intelligence systems).

In the twenty-five years since we began our artistic project, many things about life and how humans relate to it have changed. This book narrates some of these changes and concludes with our proposal, given the poverty of language especially as it relates to the concept of life, of the notion of Secular Vitalism. This is a way of being in which we extend to life special consideration that is different from our treatment of non-carbon-based things.

As ‘nature’ breaks down and we are on the verge of the so-called fourth industrial revolution, where living systems and biological processes are harnessed to undo environmental destruction and usher in a guilt-free time of plenty, we believe that critical artistic expression with and about life is called for. Our almost three decades of working in scientific laboratories and the corresponding range of scientific understanding and technological development over this time are reflected here. Those who are fa-



our work may recognize some of the discussion from numerous published papers. This is the first time these thoughts have been gathered into one extended and reflective manuscript.

We ask what compels us, or, in other words, what is the human imperative which drives us, to assert control over living systems that exist independently from us, while nonliving technologies, computer-generated algorithms and other human-made systems escape our control? Our artistic expressions are a visceral struggle to articulate our human complicity in this paradox.

This book is a hybrid product of embodied aesthetic and conceptual investigation, yet is based on contesting attempts to understand and control life. It is also a book about our own personal journey starting as young enthusiastic artists entering biological laboratories with the hope of making ‘a better world’ through advancing the knowledge and technologies of the life sciences. Once embedded in this niche and its different manifestations in the real world, we were forced into a reality check and now – older, weary and, following Haraway’s words, ‘staying with the trouble’¹ – we immerse ourselves in the unpredictability of materials and phenomena such as *sunlight, soil and shit* (the title of our most recent artistic project).

Chapter 1 goes back to the mid-nineties, when we coined the evocative term ‘semi-living’ to refer to tissue-engineered constructs/sculptures hosted in techno-scientific ‘bodies’ (petri dishes, incubators, bioreactors – manufactured devices or systems that support a biologically active environment). Here we outline the technological and conceptual backbone of the semi-living as both objects and subjects, maintaining that the semi-living applies to an array of issues, such as historical and evolving relationships with scientifically constructed living entities; the fragile and ambiguous boundaries between the living, nonliving and/or dead; the interdependency of living systems, including humans, and technology; and popular culture and political and social-based metaphors concerned with the undead, among others.

Chapter 2 explores our artistic projects which contest the DNA-centric view of life, particularly responding to the ‘genohype’ following the so-called completion of the Human Genome Project in the year 2000. Our artistic exploration challenges the scientific reductionism, and public perception, of the idea that there is not much more to life than the DNA code. We argue that not only is this wrong, but it is also an ideological stance that entrenches a chauvinistic perspective using DNA and its associated epistemologies and metaphors. We, through our artworks, called for a more contextualized and diverse view of life and the fallacy of the desire for one ‘elegant’ universalized, systematic way to explain and categorize life. This was also the time, in our own artistic development, when we shifted our interest from cells and tissues to the context within which they operate – their surrogate techno-scientific machinic bodies.

Chapter 3 takes the incubator as a starting point for the investigation of systems which support life. From the invention of the chicken incubator by the early Egyptians to current research into artificial wombs, we explore the outsourcing of care for life to the automated machine.

Chapter 4 explains how we ended up, despite our best intentions, creating artworks which became precursors to industries such as biofabrication and cellular agriculture. Here we introduce the term ‘metabolic rift technologies’ to point to the growing rift between humans and their environment, and the ridiculous fantasy of living in a technologically mediated utopia, whether it is producing food without ‘nature’ or an existence free from nature and free of consequences.

Chapter 5 illustrates artworks that explore life’s resistance to systemization and human categorization. Context again is explored through positioning living and semi-living artworks in different institutional settings – from the natural history museum to art galleries and luxury goods retailers. It is an opportunity to celebrate some of the strangeness of living systems, whether they are human-made or not.



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The concluding chapter visits and revitalizes the idea of Secular Vitalism, asking whether there is something unique to life that we can relate to (as we are life!) without resorting to metaphysical explanations. This is more of an artistic provocation rather than a careful philosophical study and it is very much needed today.

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1. The Semi-living

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The cardboard box was delivered to Traian Chirila's laboratory at the Lion's Eye Institute, an Australian medical research institute affiliated with the University of Western Australia. We opened it to discover the somewhat gruesome contents of about ten fluffy white rabbits' heads cut into halves, the white fur stained with fresh red blood. We were told that the rabbits had been slaughtered earlier that morning; the bodies had been delivered to a gourmet restaurant while the heads were sent to a neuroscience laboratory, where they were cut in half and the brains extracted to be used for research. Chirila's laboratory then received these

halved heads, requiring the eyes for research into the development of an artificial cornea.

Our next step was to ‘pop out’ the eyes. Using small scissors, we cut the skin around the eyes and severed the optic nerve at the back of the eyeballs. Once the eyes were disembodied, we immersed them in nutrient media liquid with a high concentration of antibiotics in a 50 ml flask. Once sealed, the flask was put in a fridge overnight. The following day, in sterile conditions, we learnt how to cut the eyeball open and gently dissect the thin layer of epithelial cells covering the front part of the eye. Using scissors, we then mechanically dissected the layer of tissue. With an enzymatic agent, we further separated the tissue into disassociated cells that were seeded in a tissue culture flask with the appropriate nutrient media for their growth. Finally, we placed the flask in a 37 °C incubator. In only a few hours, the cells attached to the bottom of the flask and began to multiply.

This was back in 1997, while doing a research residency¹ in a laboratory that was developing an artificial cornea.² A routine procedure of obtaining cells from a primary source (an animal body) shifted our own perception regarding life: we were able to get living cells from something as dead as half a head with no brain, more than 24 hours after the animal was slaughtered; we viscerally realized that *life* can be extended by culturing cells taken from a dead animal. Here, the boundaries between life and death are gradual, and the life (or death) of the animal is decoupled from the life of its parts (the cells). By growing living cells derived from dead flesh – with technological support – we were working with entities that were both (or neither) dead and alive. This was the first instance, as part of our artistic journey, that we encountered the *poverty of language* as it relates to *life*. We felt that there were no words to describe these different forms of liveness; therefore, we referred to the living frag-

ments from the dead rabbits, sustained alive by technology, as *semi-living* entities.

Our first series of artworks, titled simply *The Tissue Culture & Art, Stage 1*, was concerned with growing, observing, documenting and presenting partially living ‘objects’ as pieces of art. At the time we did not even entertain the idea of taking the artistic tissue sculptures to the gallery due to technical hurdles and the perceived health and safety issues of having living tissue-engineered constructs in a public space. We grew tissues (fibroblast and epidermal cells) over miniature three-dimensional glass figurines in shapes of human-made technological artefacts, such as cogwheels. We used microscopes, a three-dimensional computer scanner and medical imaging technologies to generate animated sequences, and digital montages that described the growth of the living artefact and the semi-living sculptures. We were especially fond of the artwork of a glass figurine 2 cm high and 0.5 cm wide深深 that we designed to depict the iconic image of a bomb, a symbol of humans’ destructive technologies. We grew connective tissue over its surface to later photograph its different angles, focusing on different areas, using an inverted microscope. Once we overlaid all the images (using Photoshop software) into a poetic montage, it resembled more of a fertility goddess (Fig. 1.1). Therefore, we titled it *B(w)omb*.



Fig. 1.1 B(w)omb, 1998

From the same series of works (Fig. 1.2).

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Fig. 1.2 Hamsa 1998

Looking back, the catalogue text that accompanied our first exhibition in 1998 seems very naïve and earnest (as were we), though it offers a starting point of epistemological liberation from the life sciences or biomedicine into a different, and public, context:

Current and future development in biological derived technologies, in particular in the field of tissue engineering, may yield objects that could be designed and artistically manipulated. This possibility raises many issues that have to be addressed. Those issues concern aspects of human development and scientific progress, and the interaction of humans (whatever kind they may be) with their environment. The use of artificially grown living skin (or living surface coating) as an independent tissue (by that I mean living tissue that is sustained alive and grows not as part of an organism but with artificial support) can become an exciting new artistic palette which never existed before. The use of this palette will not be just a method of creating new art forms, but also the actual process can be seen as an artistic statement and investigation of possible futures. In those futures the use of organic systems may replace and/or seamlessly interact with human-made structures to the extent that our cultural perceptions of what is alive and what is artificial will be redundant. This possible shift will represent a change in values and a shift in the perception of humans and nature. The purpose of the proposed project is to enable the artists to address some of those issues ...

Why?



To be able to use and generate a completely new art form that is yet to be explored and utilized. The manipulated growth of living cells in in-vitro conditions represents a new way for artistic expression with the unique combination of shapes, colours and movement. An exploration of such aesthetics in three-dimensional space was, as far as we know, never utilized and explored artistically.

To highlight current technological developments and their cultural and social implications. It is obvious that technological and scientific developments are exceeding the cultural capacity to comprehend these changes. This is why this kind of artistic expression is so important now. Art that can be seen as the optimal medium to generate a discussion and a debate dealing with the contradictions between what we know about the world and society's values, which are still based on old and traditional perceptions of the world.

To generate broader discussion concerning these issues and their ethics: Our project will be a genuine attempt, free from scientific or commercial hidden agendas, to raise different possibilities for the future as a base for pure discussion about the ethics and values of manipulating living matter and incorporating it with non-living systems.

To create a dialogue between the wider community and the scientific community, using art as a generator of critical and aesthetical debate.

To create a radically different point of view, from which both the wider community and the scientific community will be able to gain practically as well as philosophically and culturally.

Stage Two of the project further explored the materiality of tissue and nonliving material hybrids. In this stage, we grew muscle, epidermal and connective tissue over biopolymers. As the cell cultures developed, they grew inside the scaffolding as well as around it and had a better ‘grip’ on the structure. The result was a collection of images that documented the ‘fusion’ of living tissue with human artefacts that were presented as visual montages in the gallery space, sometimes alongside relics from the process such as the semi-living constructs with fixed dyed tissue.

We titled Stage Three of the project *Force and Intelligence on Plastic* as we extended our skills to growing muscle ('force') and neurons ('intelligence') over P(Hema) hydrogel structures we moulded in different shapes. The experiments led to the exhibition we titled The Stone Age of Biology, which was shown in 2000 as part of the Perth International Arts Festival at Scitech Science Centre in our home city of Perth, Western Australia. The context of the exhibition – a science centre – as well as the theme of the exhibition reflected that our early engagements with biotechnology were rooted in a kind of awe and the relative innocence of non-experts coming to work in a scientific laboratory. As will be shown through the narrative of this book, this changed rapidly as we further embedded ourselves within the biological laboratory, releasing the knowledge and know-how (epistemology) we gained from working in the lab to the cultural realm, which inadvertently was picked up by the consumer goods industry.

The Stone Age of Biology posited, at the turn of the new millennium, that we are in the midst of a major technological shift in which advancements in biotechnology will radically alter life in ways we cannot possibly imagine. The series of images featured mouse and rabbit muscle cells and fish nerve cells grown over hydrogels shaped like European prehistoric stone artefacts borrowed from the Western Australian



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seum. Each artefact was scanned in three dimensions using a touch sense scanner, which allowed for the creation of miniature hydrogels. In an analogy to the ways, the production of stone tools changed humans into a technology-based organism and changed human society in ways the original stone tool producers could not imagine, the same is happening now as we enter another period of technological advancement, this time with biotechnology. For the first time we are treating life – in all of its conceptions, including ourselves – as a resource for new biological tools that will be part of our industrial society. The early humans carving their stone tools was a result of a mental shift that separated them from nature for the first time, and we have never looked back.

We asked through the exhibition what kind of mental shift we would go through as part of this (bio)technological revolution? How will we treat our biological bodies? How will we perceive manufactured living matter? How much technology will invade the body and how much of the body will invade technology? (Fig. 1.3).³

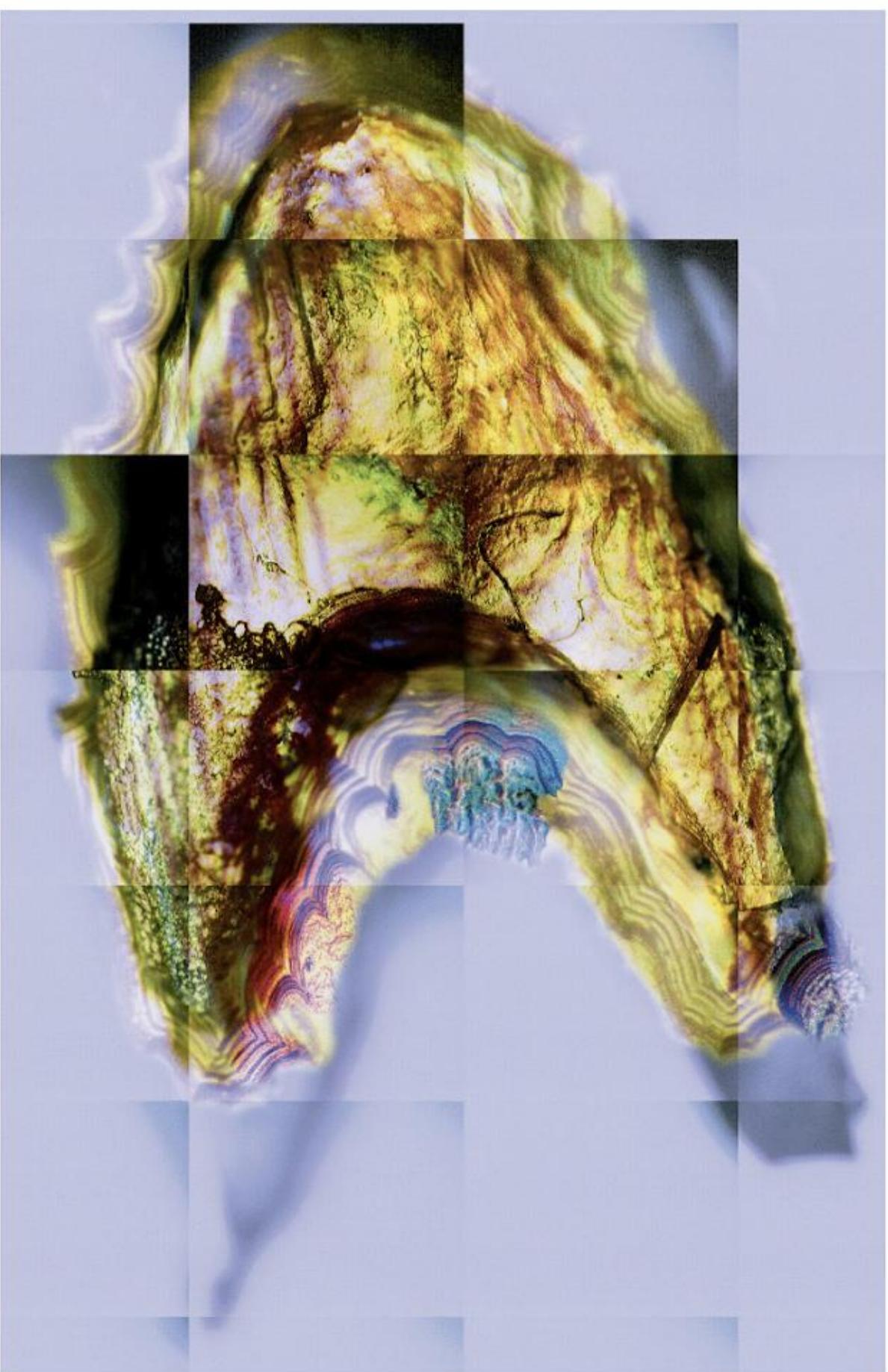


Fig. 1.3 Stone Age of Biology 2000

In order to contextualize further our own initial shift regarding our understandings of life, we need to dwell on the years back when living bodies were first fragmented into separate (semi) living cellular colonies independent of their original body.

Early Years of Tissue Culture

Much of the biomedical and biotechnological (and some artistic) research done today is enabled through experimentation on cells *in vitro*. The literal meaning of *in vitro* is ‘in glass’ and this term is now used to describe a process ‘performed or taking place in a test tube, culture dish, or elsewhere outside a living organism’.³ This research includes developing vaccines and generating antibodies. Cells *in vitro* have paved the way to fields such as artificial reproductive technologies, tissue engineering, stem cell research and development, and biofabrication (which will be further discussed in Chapter 4). Aesthetic and performative considerations, ideologies and some frivolous engagements developed alongside. Here, we would like to travel back to the early years of tissue culture and its socio-cultural and onto-epistemological affects, which linger on today.

Well into the twenty-first century, our scientific and cultural understandings of the concept of a ‘living body’ are continuing to shift. This century we have added to the mid-to-late twentieth-century dominant narrative of the body as coded DNA, offering an alternative view of the body as an ecology, not only of parts, but also of different kinds of living organism. The study of the microbiome has revealed that each body, including the human body, is a symbiont within itself – we are more than human. The human microbiota consists of 10 trillion to 100 trillion symbiotic microbial cells, primarily bacteria in the gut that play a role in our health, mood and behaviour. As this book will argue, there is a need for a further shift in the mind-set of ‘a body’ (or a self) to the understanding that, rather than a discrete entity, it is an ongoing semi-permeable process of ecological being/becoming. Yet the endeavour to understand, fix, enhance and automate bodies by fragmenting them into discrete parts is still an important part of human enterprise and is lurking in our ontological formation of discovering and articulating what life is.

The cell is considered to be, from a western materialist perspective, the basic unit of life – an organic automaton. Anything less complex than the unit of the cell is not considered to be living. The realization that communities of cells can be sustained alive and even grown externally to the body if given the appropriate conditions is not just the result of scientific advances; it has also required a cognitive shift regarding what a body is or, more appropriately, what constitutes a body as well as new interpretations of what life is. The first shift required an ‘assault’ on the notion of the singular body. In western philosophy, which is based on dialectics and dichotomies, it arose from the demonstration that an individual body can be fragmented into smaller entities or semi-beings and that these ‘collectives’ have complex and autonomous relations even when they are completely disconnected from their original host body. Hence the divide between a body and its environment is not a sealed one but rather is diffused by membranes, and furthermore the divide between a whole body and parts of a body is gradual and enables the fuzzy zone of the semi/partial living.

Philip White, writing in 1963, dated the origin of the idea of tissue culture back to Aristotle (340 BCE) and Theophrastus (320 BCE) because they described animals and plants as being made up of unified elements: blood and sap, flesh and fibre, nerves and veins, bone and wood. Malpighi (1675) and Grew (1682) theorized that these elements are literally ‘woven’ (*tissé*) into tissues of still finer elements.⁴ In 1667, Robert Hooke, using one of the earliest microscopes, observed cell structures in a thin slice of cork. He coined the word ‘cell’ as the structure reminded him of a honeycomb. As observed by Georges Canguilhem, already at this point the underlying notion of a body as a collective of cells had been raised by the choice of the word ‘cell’. Canguilhem asks: ‘Yet who can say whether or not the human mind, in consciously borrowing from the beehiv

term for a part of an organism, did not unconsciously borrow as well the notion of the cooperative labour that produces the honeycomb?' He then answers: 'What is certain is that affective and social values of cooperation and association lurk more or less discreetly in the background of the developing cell theory.'⁵ Hence the notion of the cell was intrinsically linked to a larger body, the way an individual citizen is linked to her social community and to its productive labour.

The second important development was the realization that the cell was in fact an autonomous agent, as if a ‘little body’ by itself. In making this claim, H.G. Wells, Julian Huxley and G.P. Wells argued that the term ‘cell’ was thus misleading, and offered a more ‘individualistic’ metaphor – a corpuscle. They expressed their disapproval in a somewhat emotive way in their book, *The Science of Life: A Summary of Contemporary Knowledge about Life and its Possibilities* (1929):

The word ‘cell’ is a most unfortunate word in this connection. That is why the triplex writer has put fastidious inverted commas about it in the last two sentences. He dislikes handling and using it ... and many people at the outset of their biological reading are misled, therefore, into imagining that our living tissues have a sort of honeycomb structure. Nothing could be farther from the reality. The proper word should be ‘corpuscle’ (little body) and not cell at all.⁶

Furthermore, they argued, cells which are taken away from the body and grown in vitro are cut loose from its labour: 'An organ such as the brain or liver is like the City during working hours, a tissue culture is like Regent's Park on a Bank Holiday, a spectacle of rather futile freedom.'⁷

Also implied here is that the body is like the nation state and the cells are its productive citizens.

The botanist Matthias Schleiden (1838) and zoologist Theodor Schwann (1839) were the first to formulate modern ‘cell theory’. Schwann wrote:

One can thus construct the following two hypotheses concerning the origin of organic phenomena such as growth: either this origin is a function of the organism as a whole – or growth does not take place by means of any force residing in the entire organism, but each elementary part possesses an individual force. We have seen that all organisms consist of essentially like parts, the cells; that these cells are formed and grow according to essentially the same laws; that these processes are thus everywhere the result of the same forces. If, therefore, we find that some of these elementary parts ... are capable of being separated from the organism and of continuing to grow independently, we can conclude that each cell ... would be capable of developing independently if only there be provided the external conditions under which it exists in the organism.⁸

Wilhelm Roux (1885) isolated, or removed, a medullary plate from a chick and kept it alive for some days in saline solution.⁹ Julius Arnold (1887) was ‘cultivating’ leucocytes and other cells by soaking very thin slices of pith of the Elder tree in aqueous humour from the eyes of frogs.¹⁰ These were then implanted under the skin of frogs, which were soon infected by leucocytes. He then removed the slices of pith at intervals to dishes of saline solution or of aqueous humour and observed that the leucocytes migrated from the pith into the nutrient, where

survived for some time. The first successful ‘tissue culture’ was grown by Ross Harrison (1907, 1910) when he cultivated the neuroblast of the frog in its clotted lymph and observed the growth of the fibrillae from the central body.¹¹ Harrison was able to grow and proliferate cells rather than merely sustain fragments of a body; therefore, he could legitimately claim to be the first to have successfully ‘created’ partial life. However, Harrison had devised the method only to solve a particular problem, and once this was done he made no attempt to develop it further.

Harrison experimented with isolated pieces of living frog embryonic tissue and grew them in hanging drops of frog lymph enclosed in glass slides. His aim was to view and learn about the growth of a neuron cell over time.¹² The experiment was designed for the purpose of solving a specific ‘riddle’ which puzzled neuroscientists at the time: the debate whether an axon grows from its stem (like a fingernail) or from its end part. The then method of histology, in which cells were fixed (killed), dyed and mounted on a slide as a two-dimensional specimen, did not allow such an observation. It was Harrison’s technical solution to a problem of representing change over time in living biological matter that led to the technique of tissue culture. Harrison’s ability to sustain life in *in-vitro* conditions did not come as a result of a development of a new technology but rather as a shift in and combination of ideas: ‘Any originality, therefore, that may be claimed for this work is due to combination of ideas rather than to the introduction of any particularly new device.’¹³ In retrospect, he said:

it seems rather surprising that recent work upon the survival of small pieces of tissue, and their growth and differentiation outside of the parent body, should have attracted so much attention, but we can account for it by the way the individuality of the organism

as a whole overshadows in our minds the less obvious fact that each one of us may be resolved into myriads of cellular units with some definite structure and with autonomous powers.¹⁴

Harrison did not make the mental shift that would enable him to see the long-term implications of the technique he developed not only in the scientific sense (tissue culture is a technique that is widely and extensively used for many purposes from tissue engineering to stem cell research, reproductive technologies, therapeutic cloning and pharmaceutical uses such as drug and vaccine development), but also in its radical implications to conventional ontological understandings of life, bodies and today's notion of material agencies.

Montrose Burrows (1910) studied with Harrison and introduced the idea of substituting blood plasma for lymph in the cultivation of chick cells. Together with Alexis Carrel (1910 onwards) they developed the use of embryo extracts as growth-promoting nutrient and elaborated the methods for growing a great variety of animal tissues. Carrel continued to explore the technique of tissue culture as the beginning of a wider investigation into the notion of partial life.

Alexis Carrel and Revivalism

Who shall conceive the horrors of my secret toil as I dabbled among the unhallowed damps of the grave or tortured the living animal to animate the lifeless clay?

Frankenstein, Mary Shelley

The person who made in-vitro life a central object of scientific interest and beyond was Dr Alexis Carrel. By prolonging the life of body par

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side a new artificial ‘body’, he showed that cells in culture were almost/sort of a new life form. Carrel’s assistant, Eduard Uhlenhuth, wrote in 1916: ‘Through the discovery of tissue culture we have, so to speak, created *a new type of body* on which to grow the cell; i.e., a new form of cell environment, in many respects different from the normal body that nature has given the cell in which to develop’ (emphasis added).¹⁵ Tissue culture, in a sense, coupled two opposite narratives: (1) the Frankenstein-like fantasy of revivalism from the dead (and nonliving matter) and eternal growth; and (2) the outsourcing of bodily functions and a symbolic agency to the machine (*‘a new type of body’*).

While Harrison's interest lay in observing differentiation and movement, Carrel's was directed towards observing 'life' and its essential characteristics – growth and reproduction – outside the body, as part of his continuing interest in the field of longevity, organ transplant, suturing and surgery techniques. Carrel was the first to look at the technique of tissue culture and growth of cells outside the body as a central object of interest separated from other techniques – a technology that, he believed, would enable him to capture the minimum 'essence' or vital force of life. In addition, Carrel, in the spirit of the transhumanists, believed that this human technological advancement would not only extend life but also make immortality possible.

Carrel won the Nobel Prize for Medicine in 1912 and became a popular public figure who interwove onto his discoveries ontological, political and ethically questionable ideologies far from the strictly biomedical or even scientific realms. In his visceral organism (or reduced organism) experiments, the most explicitly stated goal was to attain 'autonomous life' for isolated organs or systems of organs and to understand life processes through body reduction and the visibility of its isolated organs.¹⁶ Needless to say, these experiments involved invasive vivisection procedures.

Together with the famous aviator Charles Lindbergh, Carrel devised the organ perfusion pump, a mechanical pump for circulating nutrient fluid around large organs kept alive outside of their host body. This was successful in keeping animal organs alive for several days or weeks, but this was not considered long enough for practical application in surgery.¹⁷ To describe the use of the perfusion pump, Carrel and Lindbergh jointly published *The Culture of Organs* in 1938 (Fig. 1.4).¹⁸

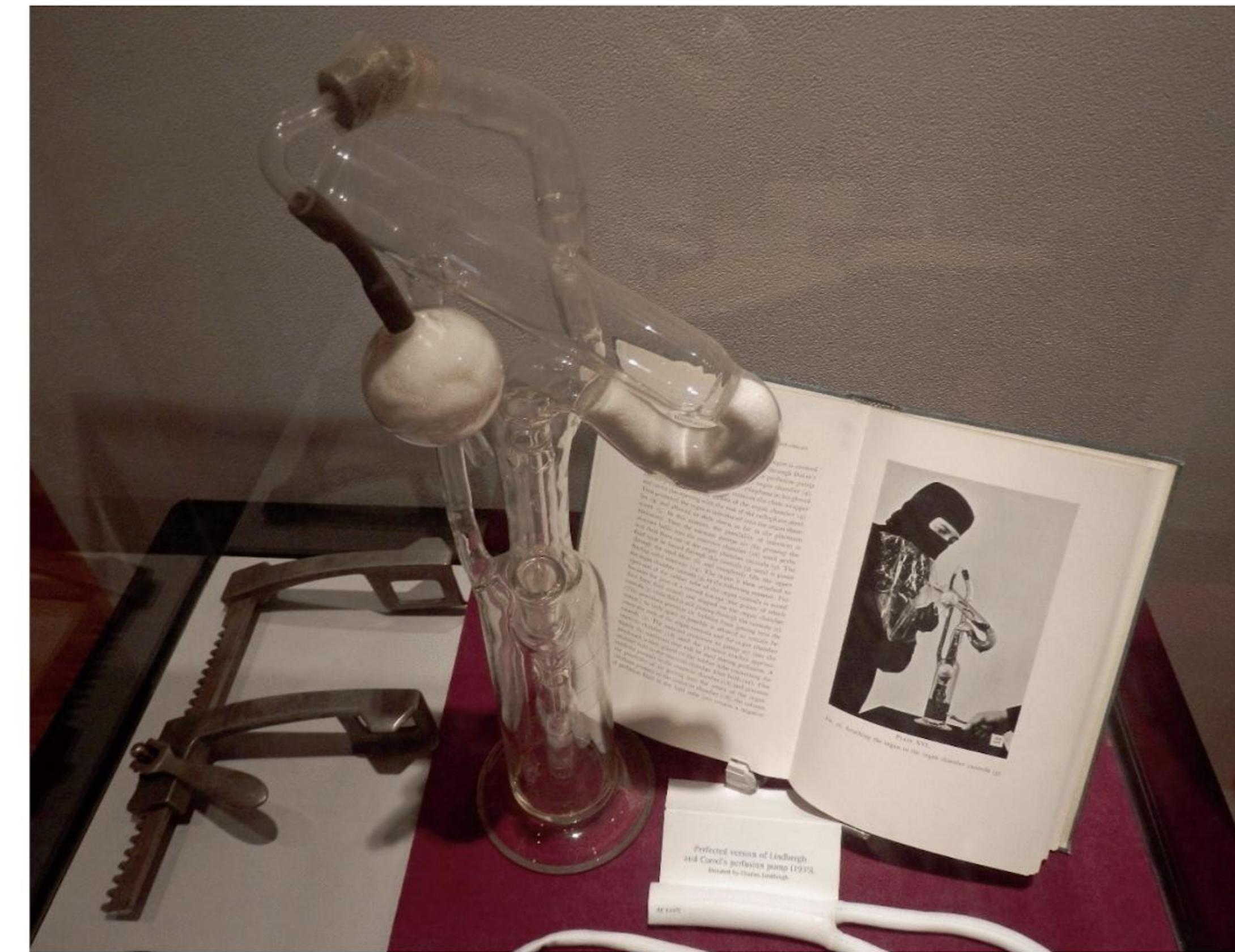


Fig. 1.4 [Carrel and Lindbergh's organ perfusion pump, 1938] on display at the [International Museum of Surgical Science](#)



The pump was a technological device designed not only for function (to maintain the life of an organ) but also for aesthetics – to present the new wonders and utopian potentials of techno-scientific advancement.

The affiliation with Lindbergh, the great American hero, extended to a shared ideology of eugenics, which Carrel outlined in his 1935 publication, *Man, the Unknown*.¹⁹ A conviction view of science combined with religious, even mystical, declarations led him to speculate on the great problems of human destiny. Carrel theorized that humankind could reach perfection through selective reproduction and the leadership of an intellectual (male) aristocracy. Through scientific enlightenment, humanity would be free from disease and would gain long life and spiritual advancement. Carrel suggested gas chambers as a solution to eradicate unwanted elements in society.²⁰ ‘Eugenics’, Carrel wrote in the last chapter of the book, ‘is indispensable for the perpetuation of the strong. A great race must propagate its best elements.’²¹ The book, a worldwide bestseller translated into nineteen languages, brought Carrel international attention. A 1954 article in *Collier’s* magazine described Carrel as, ‘A brilliant man ... Dr. Carrel made valuable contributions to the science of tissue culture’.²² Yet he is considered an eccentric mystic and fascist, or at least a Vichy-collaborating eugenicist.

The Laboratory

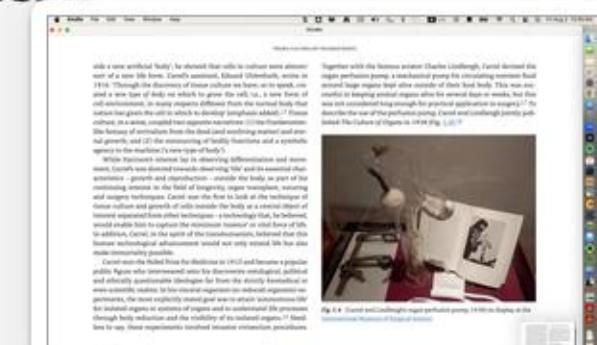
Laboratories are places of labour-performance by the living, semi-living and nonliving apparatuses (actants) occupying it. Techno-scientific innovation and performance art share elements of the spectacle, the affective and aesthetic considerations. Life sciences laboratories are also places of extraction, isolation, reductionism and manipulation, where life is controlled, colonized and mechanized.

Carrel's practice in the lab and in the public domain involved a production of elaborate theatrical performance, to the point that he was accused of being 'a hindrance rather than a positive force in the further development of tissue culture after its initial establishment'.²³ This was also due to Carrel's eccentric, mystic attitude towards 'life'; Carrel's practice and laboratory were heavily involved in rituals. While head of the laboratory for experimental surgery in the Rockefeller Institute in New York, he designed it to conduct his experiments in a unique way. His contemporaries criticized him on the grounds that he treated tissue culture as an occult art; the lab walls were grey and he insisted his assistants wear flowing black robes and hoods in the laboratory. 'The whole tissue-culture field suffered in the 1930s because of his eccentric behavior.'²⁴

Carrel together with the popular press mythologized tissue culture, as illustrated by the headlines in the *Daily Express* when he visited London in 1924: ‘Alive without a body, heart that throbs by itself. Twelve years. US wonder surgeon here’.²⁵ By giving a scientific technique a theatrical edge, whether through the use of mise en scène, performative elements, and so on, Carrel was attempting to ignite human imagination to the ‘nature’ and possibilities of these new ‘lives’.

P.R. White wrote in the 1950s:

I have sought to strip from the study of this subject its former atmosphere of mystery and complications. The grey walls, black gowns, masks and hoods; the shining twisted glass and pulsating coloured fluids; the gleaming stainless steel, hidden steam jets, enclosed microscopes and huge witches' cauldrons of the 'great' laboratories of 'tissue culture' have led far too many persons to consider cell culture too abstruse, recondite and sacrosanct a field to be invaded by mere hoi polloi.²⁶



It can be argued that the Hollywood version of Dr Frankenstein was based on Dr Carrel through the laboratory aesthetics, rituals and the mythical stories propagated about him, as well as his belief in a technological utopia that led to conceptual disastrous consequences. Carrel was called a 'modern Frankenstein'.²⁷ On 27 March 1910,

ten days after the release of Edison's *Frankenstein* – half a page of the *New York Times* Sunday edition was devoted to Carrel's success at what we would now call open-heart surgery on cats and dogs ... He stitched a damaged vein in a newborn's leg to a major artery in her father's wrist, thus creating a live transfusion that, according to the article, saved the life of the baby.²⁸

Was it the realization that complex bodies are a collection of communities of cells that led Carrel to his eugenics beliefs? The ontological questions thrown up by Carrel's scientific experiments ironically resulted in his mystic and eugenic tendencies. However, rather than looking at tissue culture or partial life as a metaphor for the human endeavour to achieve pure and perfected life, through our sometimes uneasy experience with cellular manipulations in the scientific laboratory, we have understood and communicated partial life or semi-life as a hybrid, fragile, context-dependent and far from perfect entity.

It is important in our artistic work to resurrect the tainted history of the life sciences and the deliberate or nondeliberate ideologies it raised (and raises) through our histories. As this book will demonstrate, *life* is going through yet another ontological shift with technological and automated acceleration intertwined with ecological devastation.

While the Tissue Culture & Art (TC&A) Project abhors Carrel's mysticism and belief in eugenics and considers his aesthetic accomplishments

the poor cousin of his science, his work cannot but help set the tone for aesthetic engagements with tissue culture and the disintegration of the body as a whole. It is also a constant reminder that the sciences, and especially the life sciences, do not operate independently of the society and culture they stem from.

In the early years of our practice, we had to construct a laboratory in the gallery to be able to care for the semi-living sculptures (in later years we resorted to using existing or fabricating automated systems that stood for the laboratory itself). The laboratory became a dominant mise en scène which many times overshadowed the small uncharismatic tissue construct. The laboratory acted as a functional and theatrical setting. It communicated the authenticity of the artwork (these are living, growing cells!) as well as highlighting a scientific aesthetics. In order to change the biomedical context, we had to redesign the laboratory to offer new affective scenarios and reflections.

For this reason, the design of the TC&A laboratory, used in the 2003 exhibition L'Art Biotech in Nantes, referenced Carrel's laboratory where the first successful tissue culture experiments were performed in 1910 (see Fig. 1.3).

We are interested in the wider history of the development of tissue culture technique and its different articulations, and make many references in our work to this history. Of particular importance to us have been two scientists, Honor Fell as well as Alexis Carrel, because these researchers were driven by their investigations and discoveries to ask fundamental ontological questions about the nature of semi-life (Figs. 1.5 and 1.6).

