



**STOFSKRIFTER**

METABOLIC MACHINES

THOMAS FEUERSTEIN  
at MEDICAL MUSEION

STOFSK(R)IFTER  
METABOLIC MACHINES

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STOFSK(R)IFTER  
METABOLIC MACHINES  
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# INTRODUCTION

by Adam Bencard, Martin Grünfeld, Jens Hauser  
and Louise Whiteley

This book originates from an encounter between the works of the Austrian artist Thomas Feuerstein and Medical Museion. In 2018, Medical Museion exhibited two series of Feuerstein's works, which prompted a long discussion about the complicated relationships between body, culture, metabolism and art. Yet, exhibiting Feuerstein's works at Medical Museion, a museum dedicated to broad public engagement with the culture and history of medicine, might at a first glance seem slightly curious. It is not the sort of place where one would naturally expect to find works by such an internationally recognized contemporary artist. While the boundaries between art, science and public engagement have been increasingly dented in the past decades, art institutions and museums of science and technology often cater to quite different audiences with different expectations and interests. However, when we were planning an exhibition event to resonate with the 2018 European Society for Literature, Science and the Arts' conference in Copenhagen on the topic of 'Green', Thomas Feuerstein's prolific work in the tension field between the arts, philosophy and the biosciences quickly became the 'food for thought' (and 'thought for food', as this volume will demonstrate) we intuitively wanted to be on the menu.

First, his works felt aesthetically, thematically and conceptually at home amongst the objects and exhibitions in the house, as well as

resonant with the house itself, being the former Royal Academy of Surgeons built in 1787, hosting an anatomical theatre and a historical pharmacy. Feuerstein's art crisscrosses familiar terrain for Medical Museion, including the entanglement of science and society, the status and development of scientific knowledge of the body, the promises and perils of biotechnology, and the complicated nature of medical interventions and cures. Medical Museion has been involved in bending the boundaries between art, science and public engagement for over a decade, via projects that entangle research and curatorial practice such as *Mind the Gut* (2017); *Heirloom* (2014); *Hello Bacteria!* (2014); and *Split/Splice* (2009).

Second, Feuerstein's works in general, and particularly the two work cycles central to the exhibition, *Manna Machines* and *Pancreas*, spoke in profound ways to one of our ongoing research efforts: The exploration of what might be called 'metabolic humanities'. This effort unfolds within the Program for Metabolic Science in Culture at the Novo Nordisk Foundation Center for Basic Metabolic Research, at the University of Copenhagen.

We are still bending, stretching and hammering away at this concept (or perhaps dissociating, digesting and transmuting), but one of its core tenets is a dual movement: treating metabolism as topic for humanities research, whilst

also attempting to bring a metabolic gaze into the humanities. The latter, more experimental move takes concepts from metabolic science into the development of analytical perspectives and research practices in the humanities.

Metabolic research is about the breaking down and transformation of matter; how material substances are made and remade, swallowed, digested and repurposed, moving from one system into another, in ever-expanding circles and cycles. The cow eats grass, which is digested by its gut microbes and made into other bits of cow, and those other bits move into other material and entangled systems: calves, consumers, soil microbes, atmospheres, and so on. Food is not just fuel, it is also an environment that shapes the body and is shaped in return. A metabolic gaze, if one might speak of such, is thus one that is attentive to the complex material exchanges and transformations that happen all the time, everywhere. Metabolic humanities examines what happens if we let such a gaze and its attendant material sensibilities inform and change humanities practices – from ontology to ethos.

Thomas Feuerstein's works felt like a kindred spirit in this undertaking; his oeuvre is replete with metabolic processes, full of matter being broken down and repurposed by biological organisms (including the artist himself). Feuerstein's artworks also extend a metabolic sensibility to the larger conceptual and philosophical questions it addresses. It is full of literal and metaphorical eating, digesting, and remaking; it is anabolic and catabolic, building complex artistic units from simpler ones, and breaking larger units into smaller ones, to examine and query their construction. It challenges categories of being and understanding, but always anchored to the material substrate of any such lofty endeavors; eating and thinking are co-extensive.

This volume is thus less of an exhibition catalogue as such, and more an attempt to look at Feuerstein's works as an opportunity to develop a first take on what metabolic humanities might look like. A take that is tentative and explorative in nature and pairs the material exchanges within Feuerstein's metabolic machines with conceptual interventions. Hence, the dual title of the catalogue: *Stofsk(r)ifter* and *Metabolic machines*. We are so used to thinking of machines as composed of fixed, replaceable parts, characterized by routinized functioning, and incapable of learning and growth, but Feuerstein's works show us a more metabolic machine, marked by the constant exchange, plasticity, and transmutation of matter. This kind of machine is engaged in the activity expressed by the playful Danish title *Stofsk(r)ifter*. *Stofsk(r)ifter* combines two words. *Stofskifter* refers to metabolism, and, directly translated, means exchange of matter. With the bracketed 'r' we smuggle in *skrifter*, which as a plural noun refers to writings, and as a verb refers to confessing. Not merely are these writings about the exchange of matter within Feuerstein's metabolic machines, but there is a sense in which matter is always already writing – inscribing itself in the flesh. This catalogue can also be read as a series of confessions of the flesh; a processual confession, a documentary metabolism.

The texts in the catalogue encounter Feuerstein's works by asking: What happens when we study things as metabolisms; that is, as something first and foremost characterized by material processes of transformation, digestion, excretion, transaction, and so on? And who are we, the humans as material metabolic beings producing and consuming matter, but aiming to hide these aspects when we enter the realm of philosophy, concepts and art?

**MANNA  
MACHINES**



## Manna Machines

by Adam Bencard

Thomas Feuerstein's *Manna Machines* is a series of luminous green sculptures, at first glance appearing like overgrown and aestheticized lab equipment with a touch of retro-futuristic house lamp thrown into the mix. Tangled coils of plastic tubing extend around the central glass and steel columns, forming an intricate pattern in the exhibition space. Air bubbles circulate through the tubing and the core. There are several versions of the machines, each with a different name. On display at Medical Museion is *Semmel* and *Nymphae* – bread and spirit. The *Manna Machines* are, however, not only sculptural works. They are home and host to living biological organisms, specifically the green algae *Chlorella Vulgaris*. The algae proliferate within the sculptures, growing via photosynthesis fueled by the water and air pumped through the machine along with light, natural or electrical.

*Chlorella Vulgaris* has a long history; it has been present on earth since at least the Precambrian period. Since the 1990s, it has also been mass-produced as a food supplement, celebrated as a valuable source of protein, for its high concentrations of vitamin C, and for its ability to survive in rough conditions and rapid proliferation.<sup>1</sup> As a very pliable and efficient organism reproducing itself almost out of thin air, it has also been a rich source of biotechnological dreams. It seems to offer an alternative source of proteins and other micronutrients, that does not compete with the land and resources required for traditional crops,

while also having a superior yield compared to terrestrial crops. From a biotechnological imaginary, it offers itself as a potential solution to the dietary requirements of a growing population. An organism whose metabolism is efficient enough to match the metabolism of an ever-growing human population. A (near) future food.

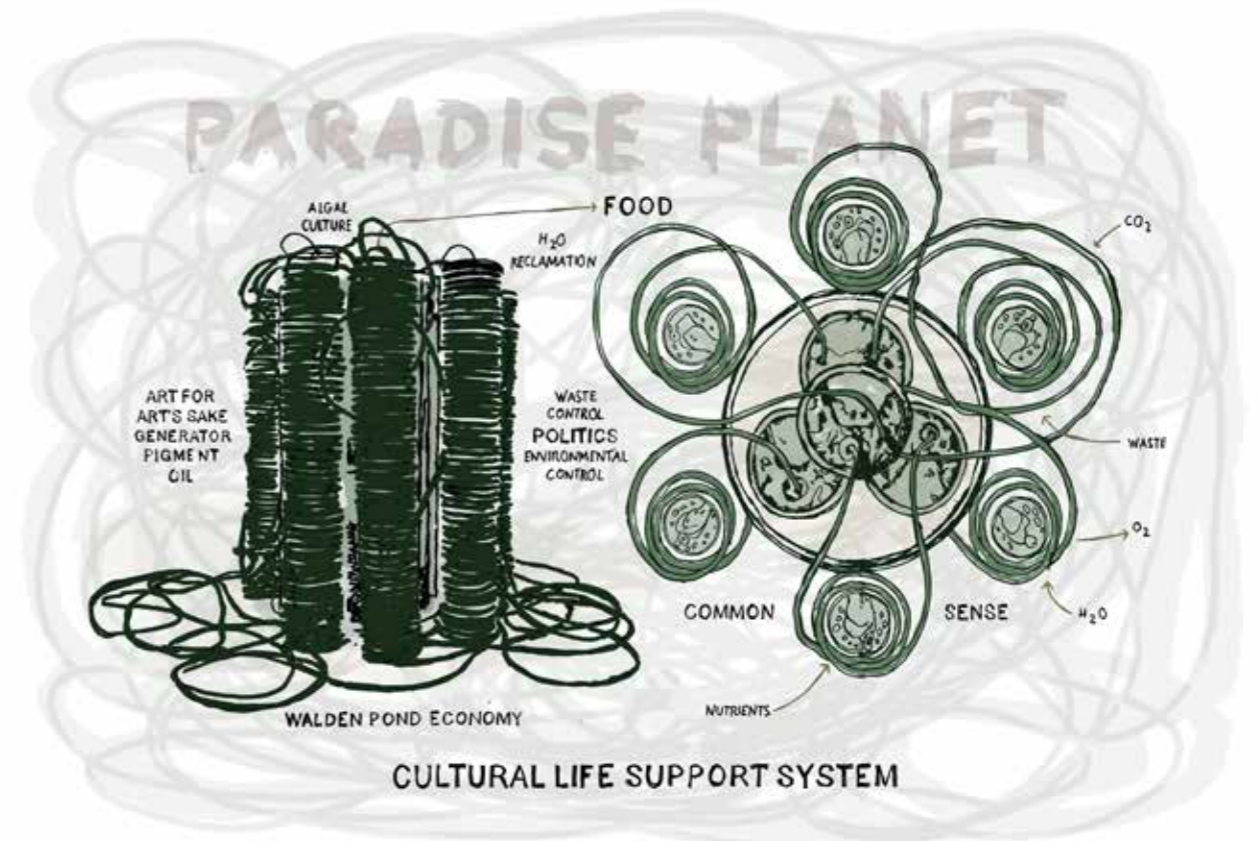
The algae appears in biotechnological dreams almost like manna as described in the bible, the edible substance that God made fall from the sky to sustain the Israelites during their travels in the desert. Thus, on a superficial reading the sculptures might be taken as an optimistic account of the potential of biotechnological and engineering ingenuity to solve one of the key challenges facing humanity in the 21<sup>st</sup> century. This account is also seemingly implied in the attendant graphical work *Paradise Planet* (2009) in which the manna machines are figured as part of a 'cultural life support system'. However, Feuerstein's playful subversion of this techno-optimistic trope is already implicit in the name *Manna Machines*. In the biblical story of manna, the name itself implies a question: When the heavenly bread began to rain down, in the original Hebrew the people of Israel asked: 'Ma'n Hu?' – English for "what is it?" The *Manna Machines* are thus, etymologically speaking, 'what-is-it machines', their very names acting as queries about the nature and status of the organisms within them, the technologies that sustain them, the intentions that put them there, and ultimately of the larger metabolic systems that they inhabit and pass through. They are machines whose name prompts us to ask, like the Israelites, 'What is it?'; what is the machine and what are the technophilic dreams attached to it?

### MANNA MACHINES, 2012

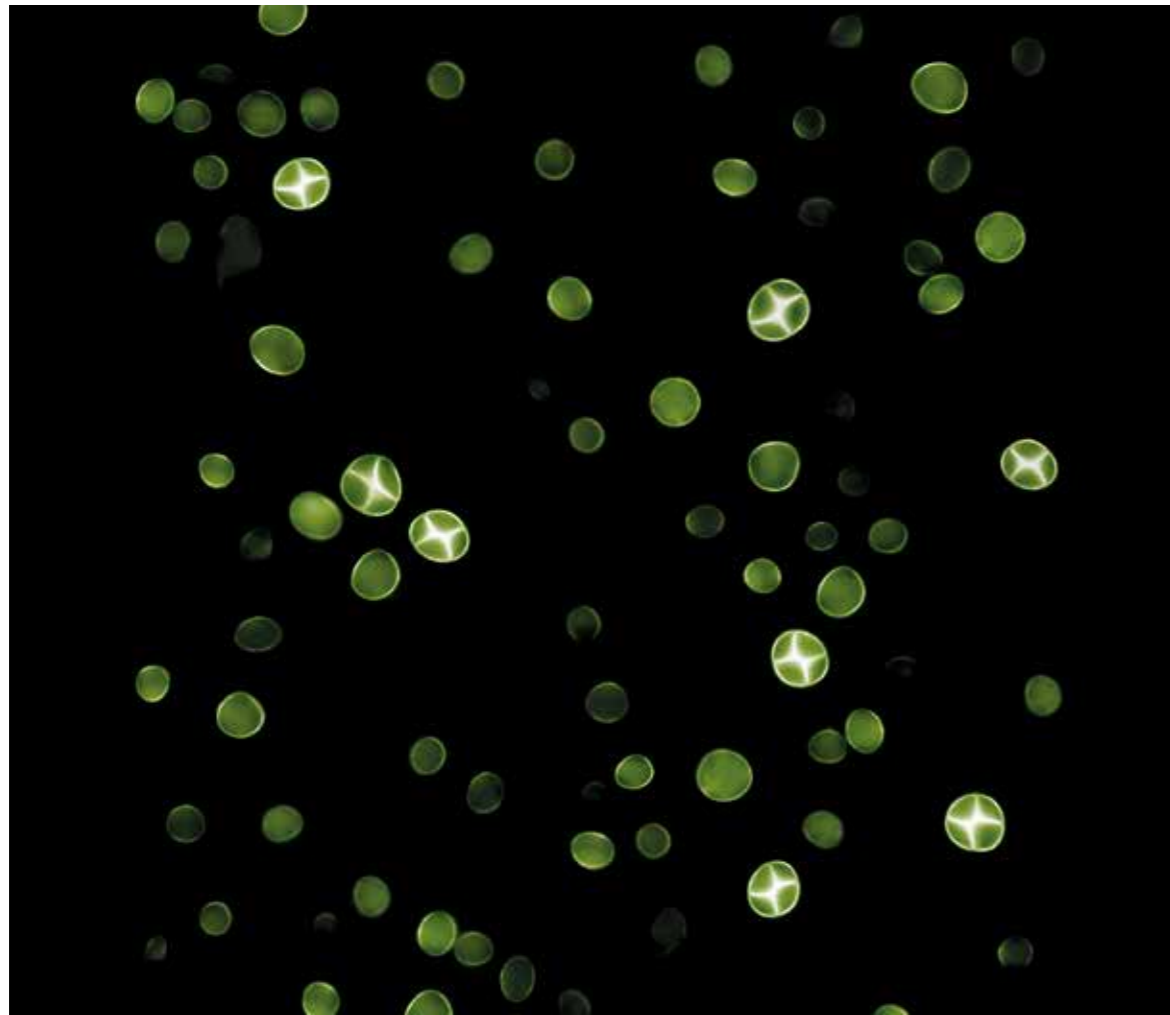
Algae, tubes, glass, plastic, pump systems.  
A selection of the different versions of  
Thomas Feuerstein's *Manna Machines*.

•

“The *Manna Machines* seemingly imply a biotechnological imaginary in which the mapping of metabolism and the caloric logic of substitution ultimately pays off; not quite the circular cannibalistic completeness of soylent green [...], but the second best: biotechnology and engineering combined to produce food from almost nothing”



PARADISE PLANET, 2009  
C-print on aluminium, 50 x 78 cm.



Light microscope image of cells of the alga *Chlorella vulgaris*, cell diameter 4-10  $\mu\text{m}$ .  
photo: Thomas Seppi, Department of Radiotherapy and Radiooncology, Medical University of Innsbruck.

Following these questions, this essay looks for the metabolic questions raised by the *Manna Machines* and the different products that Thomas Feuerstein extracts from them: Posters like *Paradise Planet*, the painting cycle *Harvest*, made with pigments produced by harvesting algae from the machines, and *Tono Bungay*, an alcoholic beverage brewed from harvested algae. Taken together, these works can be seen as a sustained artistic experiment in thinking about the ways in which we understand and relate to the expansive and continuous breakdown and transformation of matter that occur all the time, everywhere, and which stretches from the molecular machinery inside our bodies to the global production, trade, distribution and consumption of food.

**The logic of the calorie;  
or why almost no one knows what  
metabolism is, exactly**

At the outset, it seems worthwhile to reflect on the concept of metabolism itself and our everyday relations to it, as both the Danish and the English title – *STOFSK(R)IFTER* and *Metabolic Machines*, respectively – met mostly with blank stares when we discussed it with people outside of Medical Museion. ‘No one knows exactly what metabolism actually is; the word has very little everyday parlance or shared frame of reference’, one objector noted, quite rightly. Certainly, it seemed like only a very select few would look at an exhibition with that title and feel any immediate compulsion to see what would be hiding behind it. Most of us barely have a sense of our own bodies as metabolic machines, beyond vague and half-digested ideas about calories in and calories out. Not exactly a showstopper, metabolism.

By definition, metabolism is the “the chemical processes that occur within a living organism in order to maintain life; the interconnected sequences of mostly enzyme catalyzed chemical reactions by which a cell, tissue, organ, etc., sustains energy production, and synthesizes and breaks down complex molecules.”<sup>2</sup> Metabolism is thus the fundamental molecular process that maintain life in living organisms; having a metabolism is one of the standard criteria of being a living being. But what is it that has kept metabolism out of everyday frames of reference? Why is something so pervasive and essential not a part of our common vocabulary? Why is metabolism a dull, technical, sciency word? Hannah Landecker, the foremost scholar of the history and philosophy of metabolic science, notes this conundrum: “For such an interesting and curious in-between concept, one whose own definition constitutes a definition of life, metabolism by the end of the twentieth century became curiously muted and closed, a canonical matter for textbooks, not interrogation.”<sup>3</sup> This stems, she argues, in part from the history of the scientific exploration metabolism that articulated particular ideas and models of the human body.



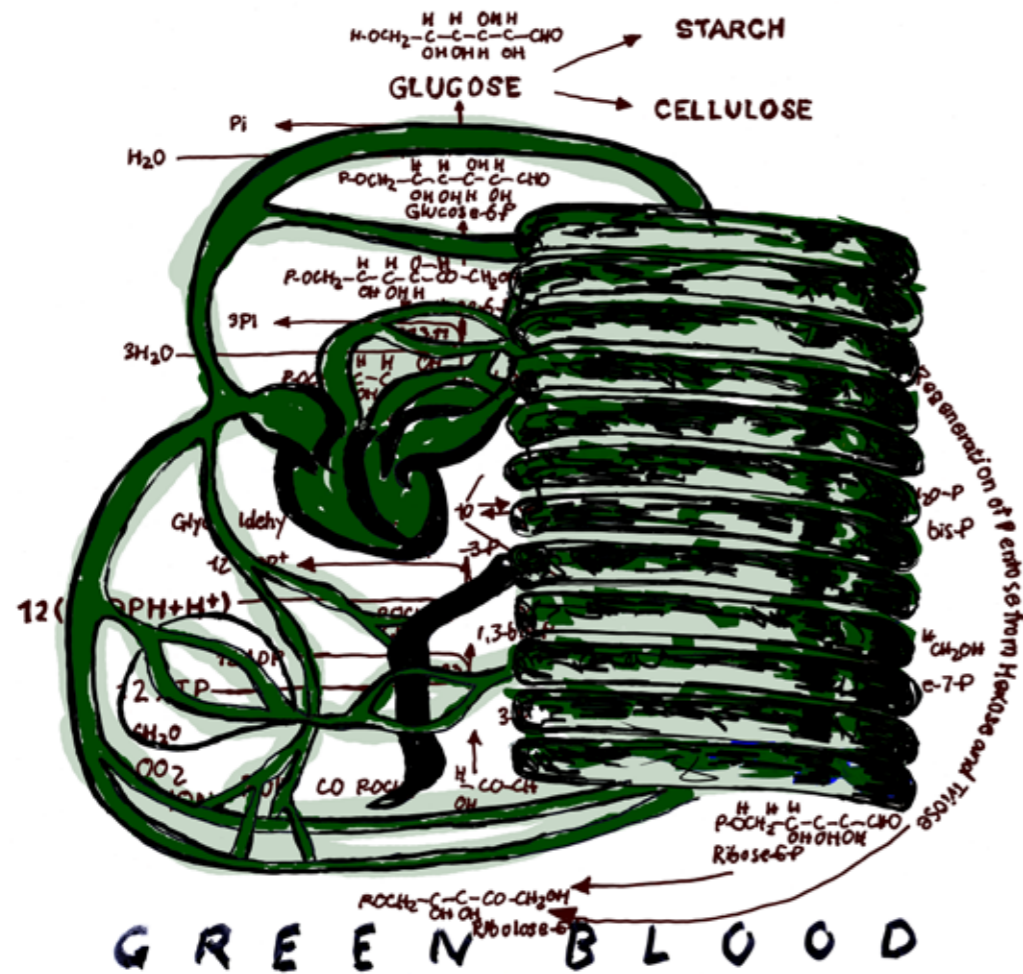
During the nineteenth century, scores of researchers used the rapidly developing tools and practices of laboratory science to study the body of humans and animals as conversion machines, analogues to combustion engines, in which food was the fuel that kept the wheels turning. This engine body was studied using detailed balance sheets, exact records of what was put in and what came out. Metabolism was conceived in and for an industrial era, focused on the conversion of matter from the raw materials of nature to the products of man – the body as industrial factory alongside the image of the internal combustion engine, the motor of the human body.<sup>4</sup> It is from this era of metabolic science that we inherited the notion of the calorie; both an idea and an instrument, as Landecker writes, that allowed food to be uniformly compared. The calorie also, we might add, largely took over for our everyday sense of metabolism, obscuring it by virtue of its seeming universal translatability.

Through the calorie, different food could be compared and evaluated in uniform ways and, by extension, so could bodies. Just like a calorie was a calorie no matter its source, so human metabolism could be lifted from the individual body and understood on its own terms, leading to an assumption of a shared uniformity across normal bodies – only a pathological body would metabolize differently from this norm. The universal logic of the calorie and its attending metaphors and meanings – such as body as machine, food as fuel, the comparability of different food to one another – was what slipped into everyday parlance, not metabolism itself. The logic of substitution was a driving motivation for this research: Already in the 1930s, researchers produced the first fully synthetic animal diet, a research discovery that was preceded by legions of laboratory rats having their diets reduced piecemeal until their minimal diet was found.

The understanding of food as fuel was sharpened in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries through the efforts of researchers such as Claude Bernard, who suggested that food was not just fuel but also building materials for the body. This led to the search for the individual chemical steps by which the body breaks down and transforms what it consumes, the so-called intermediary metabolism; in other words the biochemistry of what happens in the body between the input and output, between eating and excretion. The Krebs cycle or citric acid cycle, a process by which aerobic organisms uses stored energy to produce, amongst other things, the complex chemical Adenosine triphosphate or ATP which drives many vital life processes, was the most famous of these, still making obligatory appearances in biology textbooks ever since it was finally settled in 1937 by Hans Adolf Krebs.<sup>5</sup>



**GADGET, 2016**  
Coal on paper, 135 x 180 cm.



GREEN BLOOD, 2009  
C-print on aluminium, 45 x 42 cm

Like the image of the Krebs cycle, research into intermediary metabolism led to the production of detailed maps of the myriad of chemical reactions, metabolic pathway maps. These maps did not break with, but rather supported the universal logic of the calorie and its attendant ideas about the metabolic body. Maps of the metabolic pathways were produced, showing in biochemical detail what the accounting-like emphasis on the calorie outlines: normal bodies function by converting what they eat and drink into themselves. Only if the body was specifically pathological in some way it would not follow these shared molecular pathways. In other words, metabolic science seemed to have figured out the nature of what went in, what happened inside, and how it was converted into output. One of the deep mysteries of life – how organisms feed on other organisms while still retaining their own form and function – was considered sorted. So, metabolism disappeared into textbooks and normal science, leaving the calorie behind in the public imagination as the proxy for understanding and dealing with life in the body – in other words, food was reduced to math, the normal body a machine operating according to known laws. Food could be remade according to a machinic logic, refined, broken down and remade within an industrial-technological system, paralleling how the body itself metabolically broke down and remade what was put into it. Which in turn paralleled a vision of consumer society, a metabolism of consumption and transformation, enshrined in rhetoric of continuous, necessary growth. The science of nutrition, health and metabolism provided key models for theories of the body, both individual and social ones.

Feuerstein's *Manna Machines* and the network of paintings, posters and potable algae alcohol that surrounds them are a potent intervention in the universal logic of the calorie. Growing nutritionally rich algae with only air and sunlight seems to be a perfect modern science dream built on unlocking the metabolic secrets of the body and then hacking them, like finding a cheat code to run the machine. From science to social order, in these shining techno-scientific visions, algae come across as exemplary organisms, exemplary metabolic machines, and exemplary components of a metabolic union of body and society. As one poster reads: *With the Pencils of Nature, Politics and Technology – Draw No Distinction*. A perfect (bio-social) machine, a Paradise Planet. The *Manna Machines* seemingly imply a biotechnological imaginary in which the mapping of metabolism and the caloric logic of substitution ultimately pays off; not quite the circular cannibalistic completeness of *Soylent Green* (it's people! as the famous line from the 1973 film goes), but the second best: biotechnology and engineering combined to produce food from almost nothing; a technoscientific ideal.

**The metabolic rift;  
or, why nothing comes from nothing**

The algae produced in the machine, however, is not used to solve a global food crisis; rather, Feuerstein harvests the algae and uses them as pigments for an ongoing series of paintings called *Harvest* (2004-2012) as well as fermenting and producing alcohol, as the bottle displayed in the exhibition demonstrates. Entropy and subversion of ideals continually creep into Feuerstein's renditions of these visions, appearing literally written on the label of a bottle of algae alcohol; a bottle of metabolized spirits bearing the title *Tono-Bungay*, a reference to the title of Orson Wells's semiautobiographical novel from 1909 of the same name. In the novel, the protagonist George Ponderevo becomes involved through his uncle in the business of producing and selling a dubious patent medicine with rather unspecified contents (but probably cocaine, as many patent medicines around 1900 contained) called Tono-Bungay. From the beginning, George is aware that he is "bottling rubbish for the consumption of foolish, credulous, and depressed people" and describes the tonic as "a mischevious trash, slightly stimulating, aromatic, and attractive, likely to become a bad habit and train people in the habitual use of stronger tonics and insidiously dangerous to people with defective kidneys."<sup>6</sup> His uncle represents the systems that sells this product and is at the heart of the novel: He is a larger-than-life huckster, whose main skill in life is to dream up new products to sell, a master of advertising.

The product is a runaway success, consumed in particular by physical laborers who desire the energy and kick it brings. The strange consumerist metabolic links between social and individual bodies and their organization are clear; bodies are made to move products, some of which they consume in order to generate values in order to consume other products, and so on in metabolic circles within circles, or rather cycles within cycles. George's uncle even tries to market other products which promise to perfect digestion, in this pointed parody of health marketing scams then and now: "Why are Birds so Bright? Because they digest their food perfectly? Why do they digest their food so perfectly? Because they have a gizzard! Why hasn't man a gizzard? Because he can buy Ponderevo's Ashpit, Triturating, Friable Biscuit – which is Better."<sup>7</sup> Better digestion through technology.

The feverish and over-excited metabolism of capitalist society does not rest well with Wells, particularly in its weaponized, commercial form. This societal criticism is articulated by Wells through his narrator's admission that he almost called the novel he is writing within the novel *Waste*. As he writes in the introduction:

"It is, I see now that I have it all before me, a story of activity and urgency and sterility. I have called it *Tono-Bungay*, but I had far better have called it *Waste* [...] I think of all the energy I have given to vain things. I think of my industrious scheming with my uncle, of Crest Hill's vast cessation, of his resonant strenuous career [...] It is all one spectacle of forces running to waste, of people who use and do not replace, the story of a country hectic with a wasting aimless fever of trade and money-making and pleasure-seeking. And now I build destroyers!"<sup>8</sup>



**TONO BUNGAY, 2007**

Glass bottle, silkscreen printing on metal foil, algae distillate (*Chlorella vulgaris*), 35 x 8 x 8 cm  
The algae produced by the MANNA MACHINES are fermented and distilled to the alcoholic tonic TONO BUNGAY.



**MANNA MACHINE (detail)**  
Close up of tubes containing algae.

*Tono-Bungay*, then, is a novel of transformations, of matter being exchanged, according to a mercantile logic, which turns out for the narrator to be a destructive trap; at the end of the novel, George ends up designing a powerful warship for the highest bidders. The destroyer, named X2, is both a technological marvel of human creation and an inhuman weapon of destruction. A waste of ingenuity and technological capability, perhaps. A waste of George's abilities and his aspirations. We see the destroyer depicted on Feuerstein's bottle of algae *Tono-Bungay*, too. Are we to believe that the drink is destructive, a waste? Or, perhaps more mundanely, that the alcohol can perform a metabolic activity that gets us wasted? Whatever the interpretation, the artist seems to borrow the subversion of ideals implicit in the novel – the idealistic George ultimately being swallowed by a system he detests transformed into a cog in an ultimately wasteful industrial-technological metabolism – and uses it to his own ends. There are other metabolisms, the bottle tells us, pleasurable and artistic. Much like the paintings produced by the algae in the Manna Machines is a form of metabolic waste according to a machinic logic as they could, after all, have been eaten by the artist, they instead change matter out of one metabolic cycle into another, pointing to their subversive intertwinement. After all, who gets to decide what counts as waste?

The intertextuality between Wells' work and Feuerstein's Manna Machine marks a subversion of consumerist logics and techno-optimistic dreams of food falling from the sky. In this sense, they resonate with one of the earliest and most sustained concepts in metabolic thinking: Karl Marx's theory of the metabolic rift. During 1830–70 the depletion of soil fertility through the loss of soil nutrients was an acute concern in both Europe and North Amer-

ica. This led to, amongst other things, an immense trade in fertilizers; this included Peruvian guano (accumulated dung of sea birds) of which 220.000 tons were imported to England in 1847 alone.<sup>9</sup> For Marx, this became a symbol of the fundamental rift inherent in capitalist modes of production, a rift in the metabolic interaction between man and the earth. The intensive exploitation of the soil that capitalist large-scale agriculture was, he argued, fundamentally untenable. Marx critique was not as much leveled against science and technology as such, but rather that profit-oriented modes of production inherently made the conditions under which more sustainable modes of production could be maintained impossible. The intense removal and circulation of goods created an irreparable rift between man and nature. In Marx's view, capitalism disregarded the fundamental metabolic relationship between man and world, instead transforming materiality into capital, positing that as the ultimate good rather than the metabolic relationship itself. This transformation of metabolic relationships to capital also echoes one of the foundational critiques of modern technologies, Martin Heidegger's *The Question Concerning Technology*. In this text, Heidegger frames modern technology as a mode of viewing the world as pure resource: "Modern technology, however, exploits the land as pure resource, trying to gain the 'maximum yield at minimal expense'. Modern technology challenges the land, or whatever it happens to be exploiting, to yield more. Objects are thus revealed as pure resource."<sup>10</sup>



Maximum yield at minimal expense might almost be the catchphrase for the biotechnological imagery and ideas surrounding *Chlorella Vulgaris*, and it is this unidirectional relationship that the Manna Machines subverts by making their own transformatory patterns. Feuerstein's *Manna Machines* complicates neat, unidirectional, well-ordered metabolic pathways. The *Manna Machines* subvert by drawing no distinctions; between science and art, between consumption and transformation, between society and body. There is no simple way to summarize the metabolic poetics of Thomas Feuerstein's *Manna Machine* works; they are, like metabolism itself, processual. They spill over containers – sculptures, organisms, paintings, bottles, artist, visitors – and both signify and enact continuous transformation and remaking of matter, at once purposeful and opaque, directed and open-ended. Perhaps, then, it is suitably to re-purpose (re-digest, even) the very metabolic sentiment of the final words of George Ponderevo in *Tono-Bungay* as the final reflection of this paper:

"We are all things that make and pass striving upon a hidden mission, out to the open sea."<sup>11</sup>

- 1 Martin P. Caporgno and Alexander Mathys, 'Trends in Microalgae Incorporation Into Innovative Food Products With Potential Health Benefits', *Frontiers in Nutrition* 5 (2018). Hans Ulrich Reck, *Mythos Medien Kunst* (Cologne, 2002), 20 and 93. Hannah Landecker, 'Postindustrial Metabolism: Fat Knowledge', *Public Culture* 25, no. 3 71 (1 October 2013): 497.
- 2 Hannah Landecker, 'Food as exposure: Nutritional epigenetics and the new metabolism', *BioSocieties* 6 (2011), 169.
- 3 Hannah Landecker, 'The Metabolism of Philosophy, In Three Parts', in *Dialectic and Paradox: Configurations of the Third in Modernity*, eds. Bernhard Malkmus and Ian Cooper (New York; Peter Lang: 2013), 195.
- 4 Anson Rabinach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Irvine; University of California Press: 1992).
- 5 See Frederic Lawrence Holmes, *Hans Krebs* Vol. 1-2 (Oxford; Oxford University Press: 1991-1993).
- 6 All quotes from H. G. Wells, *Tono-Bungay* (1911) are taken from The Project Gutenberg EBook, available at <https://www.gutenberg.org/files/718/718-h/718-h.htm> (last accessed 17/12-2019).
- 7 Quoted from Peter Kemp, *H. G. Wells and the Culminating Ape: Biological Imperatives and Imaginative Obsessions* (London; Palgrave Macmillan: 1996), 125.
- 8 *Tono-Bungay*, Project Gutenberg EBook.
- 9 John Bellamy Foster, 'Marx's Theory of Metabolic Rift: Classical Foundations for Environmental Sociology' *American Journal of Sociology*, Vol. 105, No. 2 (1999), 376.
- 10 Martin Heidegger, *The question concerning technology, and other essays* (New York; Harper & Row: 1977).
- 11 *Tono-Bungay*, Project Gutenberg EBook.





## Pancreas

by Martin Grünfeld

Since its birth, Western philosophy has had its problems with flesh. The body has been downgraded to the external host of our exceptional mind autonomous from the weaknesses of a dirty animality. In a similar vein, writing has been debased as an impure medium. Fleshing out thoughts in writing has always been seen as problematic because it exposes philosophy to its alleged outside – its impure dependence on historical and cultural contexts. Despite of being deeply dependent on writing, philosophy has attempted to efface this dependence and establish writing as something purely external to the substantial ideas.<sup>1</sup> Think for example of Plato's *Phaedrus* and the banishment of writing as poisoning minds potentially leading to thoughtlessness.<sup>2</sup> To think thought as being bound to flesh (the body and writing) is degrading. Feuerstein's *Pancreas* overturns the elevation of thinking by thematizing the fleshy grounds of our thinking.

*Pancreas* is a processual sculpture that transforms books into sugar that, in turn, feeds human neuroglia cells growing in a brain-like shape inside a vat. However, not just any book is on the menu: Feuerstein has put the cells on a strict diet – nourished solely by Hegel's *Phenomenology of Spirit*. The *Phenomenology* is shredded, soaked in water, and pressed through an artificial intestine. Within the intestine, the paper is broken down into nourishing glucose thanks to the specifically engineered bacteria.<sup>3</sup> This may sound like a systematically prepared meal, perhaps best enjoyed in its wholeness

### PANCREAS (detail), 2012

Close-up of the brain-like shape inside the vat consisting of glass, brain cells, stainless steel, technical equipment.

for its true dialectical tastefulness to be enjoyed. Yet usually, books are not conceived of as food, except as food for thought. But in a strangely literal sense, Feuerstein's sculpture is metabolizing philosophy. Hegel thought he had digested all the accumulated knowledge of his predecessors.<sup>4</sup> Meanwhile, his own work is now broken down into sweet Hegelian sugar sustaining the neuroglia cells and – perhaps, one may add in a Hegelian spirit – elevating them. *But elevated to what?*

This apparently silly question is worthy of exploration because it opens a questioning not merely into the relationship between food and ourselves, but to the very conceptions of 'us' and 'ourselves'. In this essay, *Pancreas* is treated as a sculptural philosopheme that challenges us to rethink ingrained dichotomies such as subject/object, mind/matter, self/world, etc. Specifically, *Pancreas* embodies a chiasmic figure that will be explored: *thought becoming flesh and flesh becoming thought*. Focusing on *thought becoming flesh* and the material metabolizing of philosophy reveals a physical, yet also metaphorical negation and elevation of thought into flesh. But the chiasmic figure also invites us to reflect imaginatively on what happens to thought if Hegel's *Phenomenology* is the only source of nutrition. In such a reflection, *flesh becoming thought* turns into an antidote to traditional transcendental philosophy, because the conditions for the possibility of thinking are rendered material and fleshy. Delving into the chiasm, we may end up realizing that we are *all flesh*.



**PANCREAS, 2012**  
Glass, metal, plastic, paper, technical equipment, brain cells, bacteria and graphic print. Biotechnological realisation: Thomas Seppi, Department of Radiotherapy and Radiooncology, Medical University of Innsbruck. Exhibition view at Medical Museion 2018.

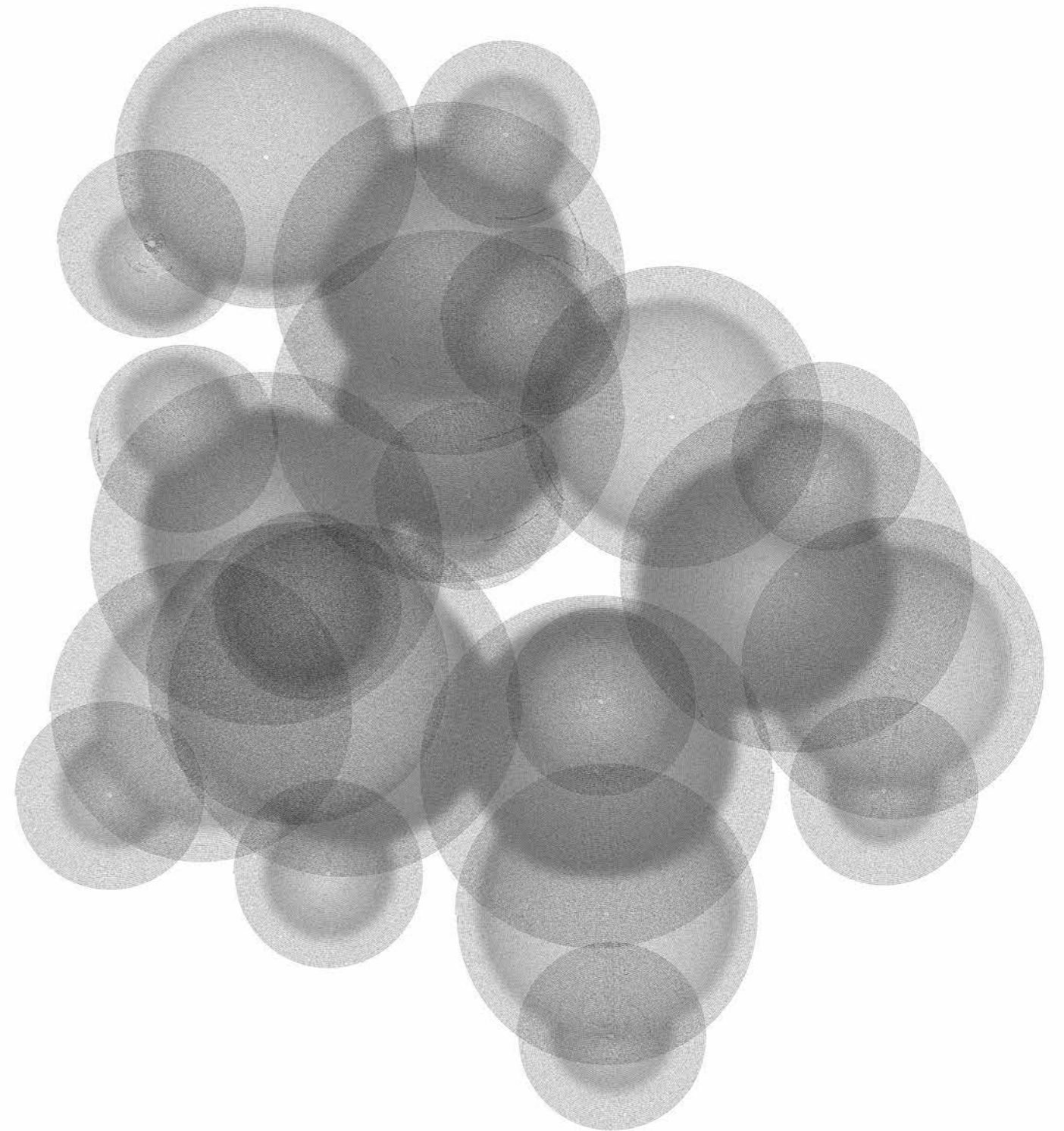


### Thought becoming flesh

In *Pancreas*, Hegel's *Phenomenology* is soaked in water, the vital substance of life. From this soaking wet condition, the *Phenomenology* becomes a book of life sustaining human brain cells through an uncanny kind of reading that perhaps could be characterized as 'metabolic'. Metabolic because of the chemical reactions and energy changes taking place in the transformation of the book into energy.<sup>5</sup> With *Pancreas*, Feuerstein has created a virtually living system with its own metabolism in which biochemical breakdown and remaking of matter takes place. The *Phenomenology* is digested in a deconstructive process from cellulose to glucose. As Feuerstein notes pseudonymously: "Glucose is the petrol of our cells. We are addicted to sugar and allow ourselves the evolutionary luxury of a large brain that burns 75 per cent of the glucose. So why not prepare physical brain food from the mental food of literature and philosophy?"<sup>6</sup> In a delightfully confusing mix-up, one material basis for philosophy – the book – is metabolized and becomes a material basis at another level, namely as the fuel for the brain cells. This metabolizing of philosophy ties together the fleshy grounds for thought – pages and brain cells; writing and matter. Perhaps thought for food?

Yet, so far what is metabolized is paper, rather than philosophy, not yet thought becoming flesh, but paper becoming fuel. Indeed, as Feuerstein points out: "For the metabolic process it's irrelevant if I feed the machine with books from Hegel, Marx or belletristic literature".<sup>7</sup> Thus, entering the chiasm – *thought becoming flesh* – demands a metaphorical displacement from paper to ink and onwards to

words, sentences, thoughts. A metaphorical displacement, however, that *Pancreas* provokes by the specificity of its nutritional preferences: not just any book is being transformed to glucose.<sup>8</sup> One is easily provoked into associating the soaking *Phenomenology* with the thoughts of Hegel, rather than the mere paper that supports them. An association that is deeply entrenched in the pre-established difference between writing and thought and the idea that philosophical thought is substantially immaterial. Yet this habitual slip cannot maintain the dichotomy it presupposes, because of the metabolic process the *Phenomenology* undergoes. Consequently, the slip constitutes the first half of the chiasm and connects thought and flesh. A metaphorical transgression Feuerstein more than hints at when he, playfully hiding under his alter ego Candyman, draws a parallel to the myth of transubstantiation and suggests: "language is translated into matter: signs become molecules, texts become cells and organic tissue."<sup>9</sup> Indeed, as the background image of Hegel's *Phenomenology* written into a glucose molecule marks, the text has been inscribed into matter – the glucose molecule carries the entire *Phenomenology* inside. From writing to the world, the word transforms to flesh – incarnated, transubstantiated. This metaphorical transgression from paper to thought resonates with a significant shift in the understanding of metabolism from a focus on energy transmission and fuel in the 19<sup>th</sup> century to information in the post-industrial 20<sup>th</sup> century.<sup>10</sup> In a physical yet metaphorical negation and elevation of thought into flesh, texts and thoughts become reality. Allowing the slip to unfold entails that not merely paper is metabolized into sugar, but philosophy.



### GRAPHIC WALLPAPER

Hegel's *Phenomenology of Spirit* reprinted in its entirety in the form of a glucose molecule to mark the transformation of the book into fuel for thought.

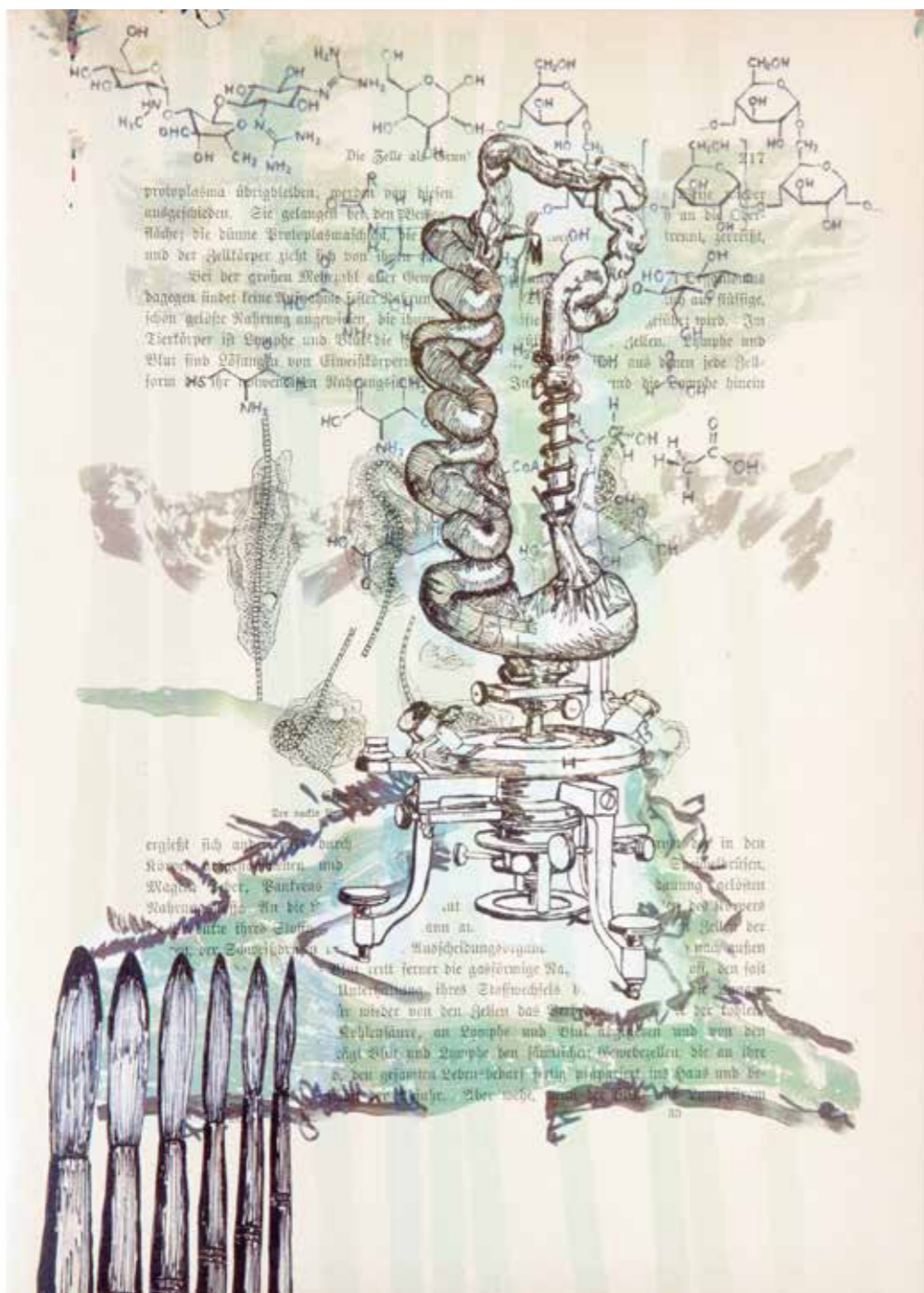


**DIE TIERE IM PARADIES, 2012**  
 Mixing technique, book material, 40 x 55 x 8 cm, plastic cover.

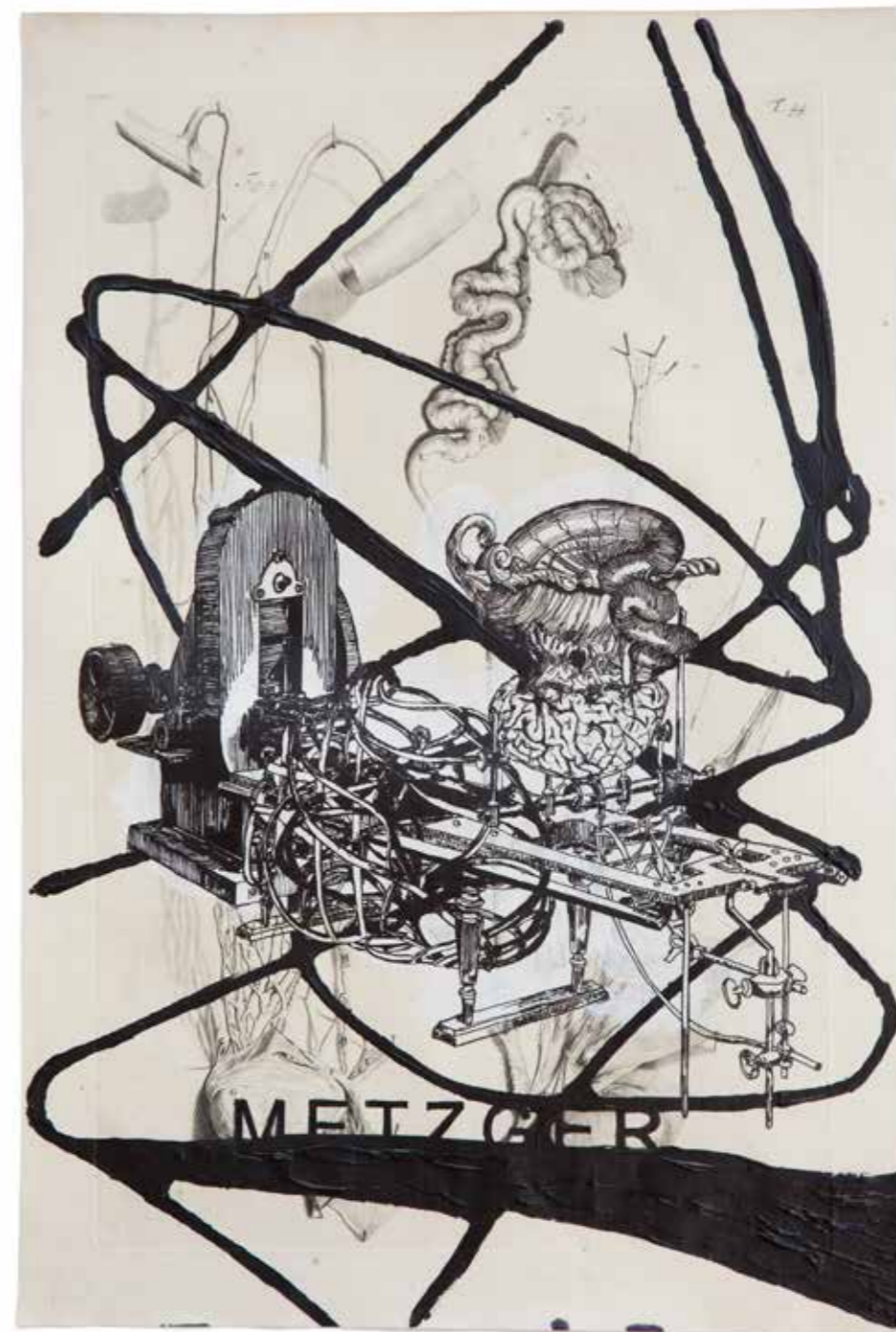
For millennia philosophy has produced a vital albeit not necessarily sweet and easily consumable glucose for thought. A tradition has emerged through commentaries and reinterpretations. In a certain sense, philosophy 'metabolizing' itself through commentaries constituting a corpus, a body of tradition. Yet commentaries can internally limit our stories and our thoughts.<sup>11</sup> Canonized works can become the fuel for doctrines potentially letting our thinking starve for centuries. If tradition is thought of metabolically, then, when it "becomes the same with the sameness of its material contents [...] it ceases to live".<sup>12</sup> So it is not enough to preserve its material contents for it to remain alive, they must be transformed. The apparently disrespectful act of soaking Hegel's *Phenomenology* and breaking down its pages within an artificial intestine digesting it, stages how metabolic reading can be an antidote to the endless commentaries constituting a tradition. Indeed, this process of digestion deconstructs the very basis for tradition – the printed page, which simultaneously becomes the biological basis for thought.

Metabolic reading is digestion. Instead of commenting: transforming. Think of how Nietzsche's aphorisms undermine our very idea of reading and commenting. For Nietzsche, the aphorism is to be read slowly: The spirit is a stomach that can be ruined by learning and reading too fast.<sup>13</sup> Reading is a process of transformation through rereading, which entails that what is digested is metabolized.<sup>14</sup> Think also of Seneca, for whom excessive reading was a distraction that led to forgetting oneself and who compared reading to digestion: "whatever we have absorbed should not be allowed to remain unchanged, or it will be no part of us. We must digest it".<sup>15</sup> As the incredible book eating boy realizes, eating too many books may not be the healthiest diet.<sup>16</sup> For Seneca digestive

reading is a way to constitute a body, which, however, differs from the body of a tradition or doctrine by being precisely the body of the one who appropriated the texts.<sup>17</sup> Likewise, *Pancreas* removes reading and thinking from the royal domain of isolated pure thought by emphasizing its connectedness to the stomach and digestion. Metabolic reading is creative; it transforms something into flesh. Or as Feuerstein puts it in the conversation with Hauser: "consuming symbols actually has a material effect on our bodies."<sup>18</sup> Our metabolic readings become part of our bodies: what we do and what we think. The mutations taking place through metabolic readings become a meta-condition for self-consistency or survival. Metabolic reading negates to preserve us and the dead texts come to life elevated: *Thought becoming flesh*.



**DARM, 2012**  
Mixing technique on paper, 34 x 26 cm, framed.



**METZGER, 2013**  
Mixing technique on paper, 61 x 44 cm, framed.

### Flesh becoming thought

How degrading for philosophy to become flesh! Although, perhaps also an alluring power to enter the bodies of others and constitute their capabilities. Yet, in the figure thought becoming flesh, we can still preserve a sense of autonomous integrity as thinkers. However, with the other side of the chiasm: *flesh becoming thought*, the very heart of philosophy is at stake. The ideal of the thinker as in a certain sense ‘dead’ is challenged.<sup>20</sup> The allegedly isolated thinker within a pure realm of ideas is confronted by the fleshy ground as a condition for thought. This confrontation is staged by the inevitable question one must ask standing in front of *Pancreas*: what happens to thinking if Hegel’s *Phenomenology* becomes its material basis? What do you become if the *Phenomenology* is your only source of nutrition?

Two possible answers develop in opposite directions and sketch out a crucial difference in our understanding of the relationship between eating, being and thinking. Either you can argue that you remain substantially unchanged or you can argue that you are at least in some sense (transformed by) what you eat. This problem resonates with the ship of Theseus, a metaphysical thought experiment questioning whether the ship remains the same if all its components are replaced. What distinguishes these strategies is that they entail radically different understandings of food – either as passive or active matter. Bennett describes this as a difference between understanding food within a *conquest model* and seeing food as an *actant*.<sup>21</sup>

In the conquest model, we do not become what we eat. Rather food is assimilated to ourselves, while we remain substantially unchanged, except of course for being nourished. This is a basic understanding of *food as fuel* characteristic of the industrial age, i.e. as something that is objectively required for building and maintaining labouring and thinking bodies. In a sense, food provides a material basis for ourselves and our thoughts, which are, however, autonomous from this material basis. Not unlike an engine, which remains substantially untouched, while machine parts give passage to fuel and waste without participating in the flow itself. In contrast, as Jonas writes, a metabolizing system is different, because it is continuously a result of its metabolizing activity. Yet in Jonas’ understanding of metabolism, the material parts of an organism are “only temporary, passing contents whose joint material identity does not coincide with the identity of the whole which they enter and leave, and which sustains its own identity by the very act of foreign matter passing through its spatial system.”<sup>22</sup> So while Jonas’ understanding is more nuanced than the conquest model, the organism remains the same self although alien matter migrates through the body. In this way, material reality becomes the biological basis for the continuous preservation of the self, which however, remains substantially different and independent except at this very basic level of preservation. Our thoughts and selves are autonomous from the flesh.

In contrast, understanding food as an actant entails ascribing an active principle to food not merely as the external fuel of an organism, but as part of what we become. It seems obvious, that food changes bodies, e.g. food can make people fatter, but what about minds, selves, and thoughts? Citing a study on young adult prisoners, which shows a reduction of

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“Today, Feuerstein’s *Pancreas* challenges us to think what it means to be all flesh. [...] Thinking does not take place in isolation but is part of our bodies and our bodies with flows, processes, and variabilities form our thoughts. The environment is metabolically inscribed in us, pervading our flesh and inflicting our thoughts.”



**PANCREAS (detail), 2012**  
 Glass, steel, bacteria, paper.  
 Close-up of the artificial  
 intestine consisting of bacteria  
 that work as molecular scissors  
 breaking down Hegel's *Pheno-*  
*menology of Spirit* into glucose.

offences committed by prisoners given omega-3 fatty acids, Bennett argues that food has the ability to alter not just bodies but minds.<sup>23</sup> Even though digestion does not depend on the workings of the mind, as Descartes argued, this does not entail that the mind remains unaffected by digestion.<sup>24</sup> Think about how digestive diseases may affect not merely your health but your self-image and affordances in the world. In the actant model of food, nutrition is an active material basis that (among many other factors) influence our thoughts and ourselves. Taking food and material substances as actants entail that they are already part of ourselves and that thinking is embedded within material substances, flows and systems.<sup>25</sup> It means that our metabolism is not a separate biological basis for ourselves, but may have bearing on who we are and what we think. More than mere preservation, our fleshy grounds transforms our thoughts. Thought and flesh are intertwined.

We now stand at an intersection between understanding flesh as something external from or internal to our thoughts and ourselves. Yet Feuerstein's *Pancreas* does not merely comprise an isolated brain in a vat, but precisely a brain connected to an artificial intestine. In contrast to Putnam's famous thought experiment, where a brain in a vat is connected to a super-scientific computer, the connection to the intestine emphasizes a somewhat dysfunctional component that is, however, simultaneously capable of aspects unattainable to a computer.<sup>26</sup> The connecting tube between the artificial intestine and the brain marks an important connection and crucial difference from a brain in a vat. It connects the brain to the stomach, which emphasizes that thinking does not happen in isolation – it is neither independent from context nor from a biological material basis. This clashes with the ideal of isolated

pure thinking. Thinking does not take place in isolation, but in the intra-action between ourselves (including brain, mind, guts), others, and the environment. This is more than just hinted at in Feuerstein's pseudonymously written short story about the scientist Soklov who, like Feuerstein, has been growing brain cells in a vat feeding on Hegel's *Phenomenology*. In the end of the story, the metabolic reading of Hegel leads the entity to reach out to the world and utter something all too familiar: "the truth is the whole".<sup>27</sup> Maybe then, we can claim that the brain somehow becomes Hegel or maybe a Hegelian or at least a commentator on Hegel?

Yet, let us be wary not to think the correlation between food and thought too crudely. Of course, you could follow Nietzsche in his preference for 'warrior food' and reject vegetables because of their role in ascetic practices, or Thoreau and his claim that eating vegetables cultivate a certain wakeful and creative sensibility.<sup>28</sup> In a sense, eating is linked to knowing, but the question is on what level? Here epigenetics may be helpful in understanding what is going on. Rather than merely fuel, current developments in epigenetics suggest that food is a form of environmental exposure and metabolism concerns regulation and information.<sup>29</sup> In this sense, food becomes an environmental actant that not merely (in)forms our bodies but even future generations. So in a weird and highly hypothetical and hyperbolic sense, the digestion of the *Phenomenology* not merely pervades the flesh of *Pancreas* but its (never to be born) children and grandchildren. To think food as an actant and to think ourselves as fleshy beings in a material world do not entail biological determinism precisely because of the inherent metabolic reading

of the environment and material basis for our self-preservation, which inscribes itself within us. A *metabolic inscription* that, nonetheless, pervades our flesh and inflicts our thoughts. *Flesh becoming thought.*

### All flesh

Four hundred years after Herophilus apparently discovered the pancreas, Ruphos named it so, meaning 'all flesh'.<sup>30</sup> Today, Feuerstein's Pancreas challenges us to think what it means to be *all flesh*. It marks a pervasiveness that not merely inflict our bodies, but also our minds. Indeed, it invites us to transgress those tired old dichotomies, which structured the world so nicely. As Feuerstein also claims: "There are no boundaries anymore, only distorted boundaries between what we used to split into nature and culture, body and mind, matter and information. This is lived non-dualism."<sup>31</sup> Thinking does not take place in isolation but is part of our bodies and our bodies with flows, processes, and variabilities form our thoughts. The environment is metabolically inscribed in us, pervading our flesh and inflicting our thoughts. Yet when there are no boundaries anymore, a consequence might be that our very notion of 'ourselves' dissolves in our pervasive fleshy existence.

Not merely Hegel's *Phenomenology* is metabolized in Feuerstein's processual sculpture, the imagined boundaries between myself, the world, and other organisms dissolve. While a brain in a vat linked to an artificial intestine through a connecting tube may appear as a closed system, it is crucial to notice that inside the artificial intestine bacteria produce enzymes that cut up the cellulose like molecular scissors and leave us with glucose.<sup>32</sup> The bacteria, which have been specifically modified to

produce glucose from shredded books, are the real protagonists of *Pancreas*.<sup>33</sup> Other organisms reside within the organism they preserve or rather they are deeply entangled parts of it. It is a reciprocal intertwining of one in the other. Even the thinker actively willing his own isolation and theoretical death for the sake of pure thought cannot isolate himself, because every human comprises a very large number of symbiotic bacteria deeply involved in the metabolic processes, especially digestion.<sup>34</sup> We are not masters of our own bodies, but comprise alien organisms.<sup>35</sup> Indeed, we are not autonomously capable of our own self-preservation expect if terms such as 'we', 'us', 'ourselves' are thought of in an extended symbiotic sense. Consequently, we can no longer separate a rational human from an external environment because we are deeply entangled with the stuff of the world.<sup>36</sup> Without such an autonomous rational 'I' pole, thinking cannot disentangle itself from bodies, organisms, and the world. This, however, is not degrading, but precisely a sublation – a *metabolic aufhebung*, which makes thinking possible in the first place.<sup>37</sup> *It is all flesh: Thought becoming flesh and flesh becoming thought.*



### PANCREAS, 2012

Glass, metal, plastic, technical equipment, brain cells, bacteria, 230 x 800 x 200 cm.  
Exhibition view of Pancreas, Galerija Kapelica, Ljubljana 2014.



- 1 Jacques Derrida, *De la grammatologie* (Paris: Éditions de Minuit, 1967), 229.
- 2 Plato, *Phaedrus*, trans. Robin Waterfield (Oxford; New York: Oxford University Press, 2002).
- 3 See also Jens Hauser, 'It's Time for a Wetware Update', in *WETWARE: Art - Agency - Animation*, eds. David Familian and Jens Hauser (Irvine: Regents of the University of California, 2016), 11-21, 17-8.
- 4 Pierre Macherey, *In a Materialist Way: Selected Essays* (London; New York: Verso, 1998), 75.
- 5 Here I use Bing's definition of metabolism to suggest what happens in the transformation of the book into energy. In 1971, Bing defined metabolism drawing on physiology and biochemistry as the 'chemical reactions and the energy changes associated with them that occur in living cells (Franklin C. Bing, 'The History of the Word "Metabolism"', *Journal of the History of Medicine and Allied Sciences* 26, no. 2 (1971): 158).
- 6 Candyman, 'Pancreas. All Flesh', in Thomas Feuerstein. TRICKSTER, ed. Hans-Peter Wipplinger (Cologne: Smoeck, 2012).
- 7 Thomas Feuerstein in conversation with Jens Hauser, 'From Metaphors to Metabols', p. 56 in this volume.
- 8 Ibid.
- 9 Candyman, 'Pancreas. All Flesh'.
- 10 Hannah Landecker, 'Postindustrial Metabolism: Fat Knowledge', *Public Culture* 25, no. 3 71 (1 October 2013): 497.
- 11 Michel Foucault, *L'ordre du discours* (Paris: Gallimard, 1971).
- 12 Hans Jonas, *The Phenomenon of Life: Toward a Philosophical Biology* (Evanston, Ill: Northwestern University Press, 2001), 75-76.
- 13 Friedrich Wilhelm Nietzsche, *Thus spoke Zarathustra: a book for all and none*, trans. Adrian Del Caro (Cambridge; New York: Cambridge University Press, 2006), pts III, 16.
- 14 Jill Marsden, 'Nietzsche and the Art of the Aphorism', in *A Companion to Nietzsche*, ed. Keith Ansell Pearson (Blackwell Publishing, 2006), 30.
- 15 Quoted in 'Self-Writing' in Michel Foucault, *Ethics: Subjectivity, and Truth*, ed. Paul Rabinow, vol. one, *The Essential Works of Michel Foucault 1954-1984* (New York: New Press, 1997), 213.
- 16 Oliver Jeffers, *The Incredible Book Eating Boy* (New York; Philomel Books, 2007).
- 17 Foucault, *Self-Writing*, 213.
- 18 Feuerstein and Hauser, 'From Metaphors to Metabols', 56.

- 19 See also Marina Vishmidt, 'The Fable of the Bacteria,' in *Allegory of the cave painting*, ed. Mihnea Mircan and Vincent W. J. van Gerven Oei (Milan: Mousse Publishing, 2015), 191.
- 20 Peter Sloterdijk, *Scheintod im Denken. Von Philosophie und Wissenschaft als Übung* (Berlin: Suhrkamp Verlag, 2010), 11.
- 21 Jane Bennett, 'Edible Matter', *New Left Review*, II, no. 45 (2007): 133-45.
- 22 Jonas, *The Phenomenon of Life*, 75-76.
- 23 Bennett, 'Edible Matter', 136.
- 24 René Descartes, *Meditations on First Philosophy: With Selections from the Objections and Replies* (Oxford: Oxford University Press, 2008), 147-48.
- 25 Stacy Alaimo, 'Thinking as the Stuff of the World', *O-Zone: A Journal of Object-Oriented Studies* 1 (2014): 9.
- 26 Jens Hauser, 'It's Time for a Wetware Update', 17-18. For Putnam's formulation of the thought experiment see Hilary Putnam, *Reason, Truth and History* (Cambridge: Cambridge University Press, 1981), 6.
- 27 Candyman, 'Pancreas. All Flesh'.
- 28 Bennett, 'Edible Matter', 138-142.
- 29 Hannah Landecker, 'Food as Exposure: Nutritional Epigenetics and the New Metabolism', *BioSocieties* 6, no. 2 (June 2011), 167.
- 30 John M. Howard, 'Pancreas History', The Pancreas Club, accessed 12 October 2018, <https://www.pancreas-club.com/about/pancreas-history/>, <https://www.pancreasclub.com/about/pancreas-history/>.
- 31 Candyman, 'Pancreas. All Flesh'.
- 32 Candyman, 'Pancreas. All Flesh'.
- 33 Hauser, 'It's Time for a Wetware Update', 17-18.
- 34 John Dupré and Maureen A. O'Malley, 'Varieties of Living Things: Life at the Intersection of Lineage and Metabolism', *Philosophy & Theory in Biology* 1 (2009).
- 35 See Feuerstein and Hauser, 'From Metaphors to Metabols', 57.
- 36 Alaimo, 'Thinking as the Stuff of the World', 12.
- 37 Not unlike Merleau-Ponty's argument that without a body, ideas would be inaccessible to us (Maurice Merleau-Ponty, *The Visible and Invisible*, ed. Claude Lefort, trans. Alphonso Lingis (Evanston, Illinois: Northwestern University Press, 1968, 150).



**LIVER, 2011**  
Sugar (glucose, isomalt), resin sealing, glass cover,  
50 x 25 x 25 cm.



**PANCREAS, 2011**  
Sugar (glucose, isomalt), resin sealing, glass cover,  
40 x 22 x 22 cm.



**EXCHANGES**

## From Metaphors to Metabols

Conversation between  
Thomas Feuerstein and Jens Hauser

May 2018

**JH:** *Stofskifter - Metabolic Machines* is the title of your exhibition at Medical Museion, where your performative devices carry out biotechnological, semantic and poetic operations alike. Your art is transformative in the very *metabolic* sense of materially putting life-sustaining biochemical processes on stage. It's also transformative in the way it provokes *metaphoric* displacements. Why is it important to combine both?

**TF:** Metaphor and allegory are common concepts in art and its history, while metabolism is a term deployed by the natural sciences to explain natural and bodily processes. In a traditional view, metaphor and metabolism thus belong to two different spheres of our culture. Personally, I'm interested not only in metaphors based on the established idea that art acts on the iconic and linguistic levels, but also in metabolisms as processes of reality that result in transformations on a molecular level. Historically speaking, I am fascinated by how this tension has played a role in art and in the hierarchization of its practices, between *artes mechanicae* and *artes liberales*. The medieval concept of *artes mechanicae* refers to a set of ordered practices or skills tied to matter, materials, processes, and – in today's language – molecules. In contrast, the *artes liberales* were

considered higher, and essential for a free person. Immaterial art. Liberal arts such as music and literature counted as theoretical and reflective, not bound by any material or physical constraints and therefore closer to the spirit – free from the body, its dirt and matter. Fine art, by contrast, was deemed trapped in matter and thus ascribed to the *artes mechanicae*, related both to machines and the inner workings of our bowels – sweat, blood and feces.

In the 21<sup>st</sup> century, this distinction is unfortunately still widely in place. Yet, with the molecular paradigm, the ancient flaw is now turned into a specific quality of fine art where it offers opportunities to work with atoms and molecules, and thus dissolve the schism between body and mind, materiality, and information. It might sound paradoxical, but the new molecular age is thus characterized precisely by the wedding of immaterial digital information and its subsequent potentials of material transformation. Coming from a very different origin, there is also the very old and weird idea of transubstantiation, called *mutatio materialis* in the medieval period: an essential element in the Catholic consecration whereby wine is transmuted into blood and bread into flesh. Here, we find another attempt to overcome the distinction between the spiritual and the material, bound to processes in biology, chemistry and physics. For me, art needs to operate in the spheres both of metaphor and allegory, and in the spheres of metabolism. This is the challenge of art in the 21<sup>st</sup> century.

**JH:** Both your works exhibited – *Pancreas* and *the Manna Machines* – stage non-human actors. In the former, photo bioreactors with live growing algae, which stand in for the greenish universe of the plant kingdom; in the latter, the reddish shimmering of brain cells in nutritive media, representing the animal kingdom. To

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“While in the 21<sup>st</sup> century creativity seems to be so important in our social context, I claim that to be creative today is to make art with *creas*, with flesh. And this kind of creativity takes place in the laboratory more than in the artist's studio. Artists today need to go beyond symbols. They need to turn from metaphors to *metabols*.”

the human eye they appear as complimentary colours, but you seem to employ their perceived greenness and redness in order to overcome the alleged opposition.

**TF:** Absolutely. The connection between both works, conceptually and metabolically, is glucose – a type of sugar essential to plant and animal life. I am fascinated by this very simple molecule produced by plants and algae, autotroph organisms able to produce glucose via photosynthesis, using their internal chlorophyll to capture energy from sunlight, transforming water and carbon dioxide into cellulose, a polymer of glucose. We are thus all feeding on the chlorophyll molecule – which we perceive as green in nature. Therefore, glucose as the fuel of life is the central point of these two works: The algae in the *Manna Machines* are living thanks to glucose, as are the brain cells in *Pancreas*. In the human body, the brain consumes a lot of glucose despite being a relatively small organ – usually 20% but sometimes up to 50% of our daily consumption. We may therefore think of the brain as an evolutionary miracle.

**JH:** The *Manna Machines* explicitly refer to another miracle; the biblical narrative of the edible substance provided by God during the Israelites' Exodus in the desert. How do they embody both the biblical belief system and the contemporary promises that techno-scientific solutions will allow for feeding the world with algae in a sustainable way?

**TF:** Machines are not often evoked in relation to religious texts, but based on Jewish kabbalistic scripts there have been speculations about the existence, and even technical reconstructions of a *Manna Machine*.<sup>1</sup> I am not primarily intrigued by the possibility that the Israelites may, in fact, have constructed such a machine, but if even religious narratives lead

to the assumption that there might have been a biblical bioreactor this is a telling sign that we, as humans, feel a strong need for a technology able to feed people and thus keep them alive. In the imaginary of a Manna Machine, it is supposed that it would actually have produced *Chlorella algae*.<sup>2</sup> Not without irony, my works refer to contemporary scenarios of such a paradise machine. In recent years, all kinds of aspirations have been projected onto algae, hopes of producing biofuel, eliminating food shortages, or halting climate change via carbon dioxide sequestration.

In my *Manna Machines*, I use this particular type of algae discovered by the end of the 19<sup>th</sup> century, *Chlorella vulgaris*, for various reasons. First, in Greek *Chlorella* means 'small green' – these unicellular micro-algae have basically the same size as red blood cells, establishing again a connection between greenness and redness. Second, *Chlorella vulgaris* is characterized by its very high concentrations of chlorophyll, and it is one of the oldest still existing photosynthesizing cells on earth. Third, *Chlorella* grows very quickly – in laboratory conditions up to forty times quicker than a typical weed – making it an ideal candidate for nutrition and all kinds of utopian thought. Fourth, in the context of biology, *Chlorella* is also a model organism and thus tells us a bit of the history of science, since the Nobel Prize in 1961 was given to Melvin E. Calvin for his work on photosynthesis in *Chlorella vulgaris*. So we have a multitude of elements coming together in these *Manna Machines*, between metabolism and metaphor, where crisis and desires, scientific and cultural histories, religion, economy, politics and issues of resources and climate converge.

**JH:** At the same time, 'greenness' is addressed here in a very ambivalent way<sup>3</sup>, since in an epoch where we start to comprehend the consequences of the Anthropocene, algae also evoke dystopian 'eco horror.' Toxic algae blooms have challenged the overused association between sustainability and greenness, and the catchphrase 'greening the earth'<sup>4</sup> has become a paradoxical indicator of uncontrolled anthropogenic effects where the notion of 'growth' is no longer positive. A planet that becomes, frighteningly, 'greener than you think.'<sup>5</sup> How do you transpose this ambiguity?

**TF:** You are right, the colour green is double-coded. We associate green with nature and growing food, but on the other side it denotes everything that is alien – therefore, in pop-culture and Hollywood movies, aliens need to be green. And indeed, many algae are poisonous, even if *Chlorella vulgaris* are friendly providers of proteins for us.

**JH:** Interestingly, your exhibition occupies Medical Museion's historical pharmacy, connecting the 'green' and the 'red' rooms. Traditionally, pharmacies have often been signalled by the symbol of a snake, often in green or inside a green cross, symbolizing its venom. According to the ancient Greek concept of the *pharmakon*, such venom can be remedy and poison at the same time. This ambivalence implies that the effects of the *pharmakon* are not just causal but always contextual.

**TF:** Yes, the pharmacy serves as the interface and as a zone of ambivalence.

**JH:** 'Green' is intrinsically associated with human perception of vegetation, which we want to metabolize as part of a 'healthy diet'. Yet at the same time, 'green' marks pathology and toxicity: greenness seems to refer to human al-

terity *per se* – welcome when outside, but unwelcome when emerging from inside human bodies. And your bioreactors where the growth of the green algae takes place are actually quite anthropomorphic, at least they match human size...

**TF:** ... yes, I like the idea that my sculptures are performers that destabilize the border between the human and the inhuman. They are more subjects than objects – they process, produce, transform, communicate and translate. And here, they produce food potentially for the artist to feed on, but also algae biomass that in the end is filtered, dried and processed into pigment to paint with.

**JH:** Ironically, pigments able to reproduce green colour are reported to be among the most toxic in art history. Despite the availability of plant based materials, pigments and dyes stable enough to technically fix green colour were long the most difficult to obtain. Organic green pigments fade when exposed to sunlight...

**TF:** ... this is why, for me, *Chlorella* is more than just an alga. It is a narrative node in my art where green as pigment and material, the history of science, nature and culture, intersect. And I like to use the *Manna Machines*, precisely, for producing pigments. Actually, I'm acting more like a farmer: I'm harvesting the algae to make dried powder that can then be mixed with oil or resin. Intentionally, my system of art-making can thus only produce a restricted amount of paintings, maybe one large or two small paintings out of one harvest, but not ten, twenty or a hundred paintings for market. And as you mentioned, chlorophyll is not a very sta-

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“We are reading, talking, learning, and consuming data like we are consuming food. Our brain performs a ‘metabolism of signs and symbols’, and we have digestive systems, memory and storage in our brain and in the rest of our body alike.”

ble molecule. Under sunlight, ultra violet light, it turns yellow, brown, or ochre. But the unicellular *Chlorella* is quite well protected thanks to its cell membrane, which contains a lot of cellulose that protects it from the effects of light. Of course, during the first months the paintings are much greener and brighter than after one or two years; but then the fading process stops and they remain olive green, like mature Bordeaux wine in ‘red’.

Beside green, I produce two more colours with *Chlorella*: black and beige. The first technique consists of slowly heating up *Chlorella* algae powder to an elevated temperature without oxygen in a high-pressure reactor so that it turns black. This process is called hydrothermal carbonization, which means that coal is being produced. And that coal can be used as a pigment for paintings, or to produce charcoal crayons, a very traditional material in artists’ studios. The second way to produce pigment is to burn and to wash the material in order to obtain potash. In the past, potash was processed mainly into gunpowder or soaps. My main point is not just to produce different colours for paintings or drawings, but to address the cultural history underlying the different metabolisms – between hygiene, warfare, and coal mining that dominated the 20<sup>th</sup> century’s economy.

**JH:** With the promise of an ecological transition that may replace fossil fuels by plant- or algae- based combustibles, ‘green is the new black’ – yet you are reversing the metabolic processes such that ‘black is the new green.’

**TF:** Of course, crude oil and coal are black, but they are also the long-term result of the transformation of plant materials. And now we try to substitute ‘black’ by ‘green’ energy. At the same time, I am fascinated by the process of hydrothermal carbonization invented by the German chemist Friedrich Karl Rudolf Bergius in 1913, because this process imitates coal formation taking place in nature over 50.000 to 50 million years, but within just a few hours. Bergius also carried out experiments with high-pressure chemistry that are really interesting with regards to the origin of life as such. Could it be possible that life originated under these conditions? Some scientists argue that the pressure and temperature are too high; others assume that it is precisely under such conditions that new molecules might emerge. Bergius is another inspiration for my glucose sculptures displayed in the pharmacy. He experimented with processes of hydrolysis in order to produce sugar from wood – a process I am replicating with the *Chlorella* algae with their thick cellulose cell membranes. Since cellulose is a polymer of glucose, I can use special enzymes to break down cellulose and produce glucose – which, in turn, becomes the point of departure for new art works. In some cases, I have used this glucose to make invisible images by employing colourless glucose mixed with water. This becomes a trap for *Drosophila melanogaster* flies – which are, like *Chlorella* algae, a model organism in the sciences. The flies are attracted by the sugar, get stuck and die as pixels, revealing the image on the canvas.

**JH:** Glucose then becomes the fuel of thought in your performative installation *Pancreas*, which grows human neuroglia cells in the shape of a brain. Evoking the brain’s position between spiritualism and metabolism, you feed the neuroglia with glucose, derived from specifically modified bacteria that produce glu-

cose by breaking down cellulose from shredded books. 'Food for thought' becomes 'thought for food,' with the engineered bacteria as the real protagonists.

**TF:** You're right. The bio-fermenter is the central piece of the artwork. It contains specially optimized bacteria able to produce cellulase, the enzyme that breaks cellulose down into glucose. Human beings are not able to perform this process, but cows and other animals feeding on grass or leaves have such bacteria in their stomach. That is why we humans have always needed other animals as bioreactors, vegetating and producing cheap glucose and other nutrients. So, in this interplay of metabolism and metaphor, on the one side we have a simulated cow stomach, and on the other human cells growing into the shape of a brain, with all its allegoric associations as the locus of the spirit, the soul, intelligence and intellect.

**JH:** However, the feeding of the artificial brain follows a strict diet, which exclusively consists of Hegel's *Phenomenology of Spirit*...

**TF:** ... which of course is an ironical statement. For the metabolic process it's irrelevant if I feed the machine with books from Hegel, Marx or belletristic literature. But for the symbolic sphere it's important since metaphors depend on context. One reason I use the *Phenomenology of Spirit* is that Hegel makes large claims about the human being and the development of society, but he also states that people won't need art anymore—which is a very interesting affirmation. He advocates rather for a society of art and spirit, where the distinction between everyday life and art life would no longer be necessary.

**JH:** This transposition of language and symbols into living matter counter-balances our general assumption that we, humans, make meaning out of matter by the process of interpretation. So it seems, then, that *Pancreas* destabilizes the assumed centrality of the human species in the making of meaning. This reinforces a central tenet of biosemiotics, which assumes that not only cognitive but any biological process can make meaning: 'life makes sense', but in a totally non-spiritual understanding.

**TF:** This is a crucial point of the work, and we may speak of a 'symbolic metabolism'. We are reading, talking, learning, and consuming data like we are consuming food. Our brain performs a 'metabolism of signs and symbols', and we have digestive systems, memory and storage in our brain and in the rest of our body alike. Let's consider that our memories are like fat. If we are very fat we have a lot of memories and knowledge stored in our brain. But utopian science fiction predicts that we will soon have direct interfaces between molecules and memories. So a fictitious idea is that I would be eating and reading Hegel at the same time. The German Romantic writer Jean Paul describes a related situation where he is reading, and afterwards not hungry anymore. I think that consuming symbols actually has a material effect on our bodies.

**JH:** You often include bacteria in your art and emphasize the need to recognize the incredible potential of their non-human agency. You seem to promote a view very different from human exceptionalism and individualism, a view that allows for a more collective and ecological conception of the human body.

**TF:** In the last twenty years it has become increasingly clear that a human being is not a hermetic entity. We are full of alien organisms, with more cells of other organisms than human cells in our body. And it has been very fascinating for me that if we were 'purely human' we would die very quickly. Not only are symbioses valuable for our metabolism, but microbes are also influencing our thinking, feelings and emotions. So there is no point in saying 'I'm the author of my ideas.'

**JH:** Your bioreactor displays seem to host dynamic but homeostatic processes in total equilibrium, with an input and an output, but controlled to keep their balance. All these glass containers seem to hold the illusion of unlimited growth, where decay can be circumvented – the fulfilment of the ultimate dream of negentropy?

**TF:** In his seminal book *Chance and Necessity*,<sup>6</sup> Nobel Prize winner Jacques Monod formulated the idea that life itself is based on negentropy, the need to minimize the entropy of the environment and to create and maintain order via organization, structure and function; the opposite of chaos and randomness. So you are right, this idea is conveyed and strengthened by the large industrial bioreactors, instead of displaying such processes in small laboratory flasks. I also like the aesthetics of such laboratory equipment. It reminds me of the 19<sup>th</sup> Century including the aesthetics of Jules Verne's *Nautilus* under the sea. I'm a sculptor, and I'm interested in a sculpture not just as a form in bronze or marble, but as a literally alive performer, producing molecules, amino acids, proteins, new cells. And these processes of growing are to me like writing a text.

**JH:** All your titles have multiple layers of meaning, a conjunction between matter and language – so *Pancreas* can't just be evocative of the digestion-enabling organ...

**TF:** I like the word *Pancreas*, going beyond the name of the organ. It's a hybrid term composed of *pan* meaning 'all', and *creas* meaning 'flesh'. As an artist, I'm of course also concerned with the notion of creativity. However, etymologically speaking, *creativity* and *creas* have nothing to do with each other. While in the 21<sup>st</sup> century creativity seems to be so important in our social context, I claim that to be creative today is to make art with *creas*, with flesh. And this kind of creativity takes place in the laboratory more than in the artist's studio. Artists today need to go beyond symbols. They need to turn from metaphors to *metabols*.

Transcription: Maja Höhn

1 George Sassoon and Dale, Rodney, *The Kabbalah Decoded: A New Translation of the 'Ancient of Days' Texts of the Zohar* (London: Duckworth, 1978).

2 George Sassoon and Dale, Rodney, *The Manna Machine* (London: Sidgwick and Jackson, 1978).

3 Jens Hauser, 'Greenness: Sketching the Limits of a Normative Fetish', in *The Aesthetics of Necropolitics*, ed. Natasha Lushetich (London: Rowman & Littlefield Publishers, 2018), 97-118.

4 Zaichun Zhu et al., 'Greening of the Earth and its Drivers'. *Nature Climate Change* vol. 6 (2016): 791-795.

5 Ward Moore, *Greener than you think* (New York: William Sloane Associates, 1947).

6 Jacques Monod, *Chance and Necessity: Essay on the Natural Philosophy of Modern Biology* (New York: Knopf, 1971). Original French version: *Le Hasard et la Nécessité: Essai sur la philosophie naturelle de la biologie moderne* (Paris: Éditions du Seuil, 1970).

## Media and Metabols<sup>1</sup>

by Jens Hauser

Imagine that we ask biological researchers, instead of the typical luminaries knowledgeable about contemporary art or the humanities, to show us their 'media'. They are unlikely to come up with a television or a tablet computer, or to show up in the company of a visionary shaman. However, they may bring a flask of nutrients serving as growth media for cell cultures, or even a thermocycler; a kind of molecular photocopying machine. When media change technically, they also change our idea of what a medium is. It is therefore necessary to reflect on the historical, etymological and epistemological derivation of the seemingly self-evident term 'medium', and on how, under the influence of the natural sciences, the meaning of the concept of media-ality itself mutates. Which media would media artist Thomas Feuerstein come up with?

The often ambiguous recourse to the concept of media art is due, on the one hand, to the pervasive integration of electronic devices that transmit images and sound or perform communication and information processes, and on the other, to experimental practitioners' desire to distance themselves from the established contemporary art system. However, the technical characteristics and functions of the specific apparatuses used by artists can hardly be considered as marks of distinction anymore. When attempting to define media art, it is not relevant, as Hans Ulrich Reck states, whether "network art, computer art, video art, pigment

art, oil art, painting art or sculpture art is art or not, but rather how the production technologies and the physical-chemical, biotechnological and mediated-procedural modes of conception and execution enable, hinder, modify and characterize those products that, in accordance with a particular society's view of certain methods and objects, are referred to as 'art.'" Rather, "art in the focal point of mediatization is of interest as a specifically inspired capacity to tie together vision, knowledge and the world of everyday life."<sup>2</sup>

All of the media listed above have been making up Feuerstein's works for the last three decades. We encounter supposedly classic objects such as sculptures, installations, drawings, paintings (often made with specifically synthesized pigments) and photographs – which is why the name of Feuerstein is not spontaneously associated with media art only. His works also include video, audio dramas, stage plays, robotics, Internet or Artificial Intelligence-based works, as well as increasingly biotechnological works. Here, biomediality is employed either as life-enabling *milieus*, bio-technological *means*, or instances of *measurement*.<sup>3</sup> This eclectic variety does not, however, fuel a new facet of the historic *paragone*, the comparison and competition between art techniques and genres. On the contrary, it asks for a specific media adequacy, thanks to which the artist identifies the immanent dynamics in the transformative or narrative processes at stake, in order to translate them into singular art forms and media combinations.

It is therefore unsurprising that Feuerstein has never been the strongest advocate of interactive digital art. Not out of disinterest in the promises of democratizing participation, but rather out of restraint and scepticism vis-à-vis dominant 'push-the button' or 'imposition

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“Aliveness is conceived as an autopoietic process producing meaning, not just limited to glucose-wasting cognition and consciousness of the human brain. Aliveness is permeated per se with ‘meaning’: Life – makes – sense. Love, poetry, theatre, molecule.”

of hands' aesthetics often found in art whose human-machine interfaces make *Homo faber* interact with its own technical creations.<sup>4</sup> He may sympathise more with art theoretician Louise Poissant's suggestion to replace the term *interactivity* with the term *alteraction*, which "puts the emphasis not only on the action but also on the encounter with the other";<sup>5</sup> encounters with non-human actors – from the animal, plant and mineral kingdoms – are at the heart of the matter of Feuerstein's media art. In early works such as *Hausmusik* (1993), he addresses how the Greek concept of *oikos* has shifted from ecology to economy. Stock market data (with the related animal allegories, such as the bull standing in for *hausse*, and the bear for *baisse*) were converted into an automated violin and piano concerto, in which the traditional authorship of the composer is superseded by the crazed metabolism of the financial markets. *Honeymoon* (1996) stages a likewise metaphorical and physiological marriage between the artist and a rubber plant (*Ficus elastica*) imported from India. A marriage fulfilled in *Biophily* (1993-2002) where gold particles were coated with the artists DNA and injected into the rubber plant's cells with the help of a so-called particle- or gene-gun. With *Onko-Shirt* (1998), he anticipates the biotechnical production of artificial skin, by culturing and tattooing miniature trousers and jackets from his own fibroblasts mixed with collagen in growth media. On the other hand, his *Mikrobograph* (2002) stands in the tradition of technical media that provide analysis and observation. A modified Hasselblad camera enables the artist to filter microorganisms out of the air to produce images. Freely adapted from Henry Fox Talbot's 'pencil of nature', this media archaeological *clin d'œil* replaces light exposure with aerial exposure, revealing microbial traces on an agar-agar film. In *Manna Machines* (2005-), *Chlorella vulgaris* algae are grown,

on the one hand, to feed *Drosophila melanogaster* flies and, on the other hand, generate pigments for the artist's autarkic painting practice. Finally, in *Prometheus delivered* (2017), a large-scale installation that takes the form of a gigantic laboratory, stone becomes flesh: a replica of Nicolas-Sébastien Adams's marble sculpture *Prométhée enchaîné* (1762) from the Louvre is decomposed by chemolithoautotrophic bacteria, the latter providing nutrients to grow a form out of human liver cells. Nevertheless, Prometheus, the Titan chained to a rock for eternity to have his liver eaten daily by an eagle, is not the protagonist in this process – the stone-digesting bacteria are! They feed on hepatic pyrite, organ-shaped aggregates of iron disulfide; also known as marcasite – a term derived from the Arabic for 'firestone', indicating that they give off sparks when struck against harder materials. In German... Feuerstein – *nomen est omen*, it's all in the name.

For Thomas Feuerstein, biomedial based art practices should not be seen just as the new avant-garde or a techno-affirmative trend. Rather they should be linked to our traditions of imaginaries in order to give rise to new interdisciplinary connections. He rarely comments directly on his works; most often his points of view are anonymously expressed in the form of science-fiction texts, interwoven with diverse discursive elements of his work. "Cultures consist of metaphors, and metaphors are the flesh of cultures," he writes under a pseudonym, at a time when "the place of creation [...] has shifted from the artist studio to the laboratory of the biosciences, where images and sculptures, furniture, clothing and computers, are being cultured today."<sup>6</sup> A Prometheus of new media, Feuerstein arranges his performative displays

so as to carry out biotechnological, semantic as well as poetic operations alike. At the same time, he picks up biosemiotic concepts while emphasizing the crucial role of nonhuman agents: the interpretation of signs takes place on all planes of the living. Aliveness is conceived as an autopoietic process producing meaning, not just limited to glucose-wasting cognition and consciousness of the human brain. Aliveness is permeated per se with 'meaning': Life – makes – sense. Love, poetry, theatre, molecule. "Artists today need to go beyond symbols. They need to turn from metaphors to *metabols*."<sup>7</sup> Feuerstein sees the *metabol* as a link between the logics of the humanities and the natural sciences, as a possibility to overcome historically inherited hierarchies between the *artes mechanicae* and the *artes liberales*. While the *artes mechanicae* ranked low in the hierarchy of the arts, since they were tied to matter and were often practiced mainly for a living, the *artes liberales*, including music, poetry or rhetoric, were considered as immaterial and thus of higher value. Feuerstein considers that this hierarchy needs to be overcome in today's molecular age "characterized by the connection of digital – that is, virtual and immaterial – information and its subsequent potentials of material transformations that emerge." Following this argumentation, "the ancient flaw is now turned into a specific quality of fine art, where it offers opportunities to work with atoms and molecules and thus dissolves the schism between body and mind, materiality, and information."<sup>8</sup>

Thereby, the interlaced levels of reflection – object, metaphors, metabols, technology, epistemological context, the role of art, etc. – at times pertain to vastly different periods. Techno-sciences today have become powerful producers of aestheticized images: this calls for an analysis that is not based primarily on imagery but on their underlying material media and epistemic connections. Phenomena that once assumed the form of artistic images are being translated, scattered and fragmented, here, into a variety of instances of mediality – and they are not only means to an end, but fully integrated elements of the aesthetic object.

1 In 2019, Thomas Feuerstein received the prestigious Austrian National Media Arts Award for his work. The text reprinted here has been commissioned by the Austrian Ministry of Culture on this occasion.

2 Hans Ulrich Reck, *Mythos Medien Kunst* (Cologne, 2002), 20 and 93.

3 Jens Hauser, *Biotechnologie als Medialität – Strategien organischer Medienkunst* (Doctoral thesis. Bochum, 2014).

4 Jens Hauser, 'Who's Afraid of the In-Between?', in *sk-interfaces. Exploding Borders - Creating Membranes in Art, Technology and Society*, ed. Jens Hauser (Liverpool, 2008), 6-17.

5 Louise Poissant, 'The Passage from Material to Interface', in *MediaArtHistories*, ed. Oliver Grau (Cambridge, 2007), 244.

6 Candyman (Thomas Feuerstein), 'Pancreas. Alles Fleisch.', in *Thomas Feuerstein. Trickster*, ed. Hans-Peter Wipplinger (Cologne, 2012), 237.

7 'Thomas Feuerstein & Jens Hauser in Conversation. From Metaphors to Metabols.' In this volume, p. 57.

8 'Thomas Feuerstein & Jens Hauser in Conversation. From Metaphors to Metabols,' 50.

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By Adam Bencard, Martin Grünfeld,  
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