The Artwork as a Living System

By Karin Ohlenschläger

Introduction

Christa Sommerer and Laurent Mignonneau first published the concept of *Art as a Living System*[1] as the title of an essay written together with Machiko Kushara in 1996. This idea can be understood as a central aspect of their entire artistic oeuvre and as leitmotif of the current retrospective.

I would like to use this focus to take a closer look at the long-term work of the two artists against the wider background of the ideas of life in science and art.

As will become apparent over the course of the explanations, life cannot be comprehended as a single entity, but rather, only quasi discourse-immanent in a plurality of various perspectives. Like in the parable of the encounter of blind persons with the elephant, every discipline describes that part of the huge animal that it can grasp, or which corresponds with the respective field of knowledge. What unites nearly all, in turn, is an idea of immensity, or a certain blurriness, insofar as now, like before, where, or from which concrete moment life can be considered as such is not always possible to determine. Taking a closer look at this discourse-immanent indeterminacy promises a better understanding of the scope of the two artists' oeuvre.

In their texts, they refer to numerous insights from biology, cybernetics, and research on artificial life (AL). I would like to add to these a few somewhat less frequently discussed positions within the research of life and include other fields of knowledge, such as biocommunication and endosymbiotic theory.

For this, I will first sketch out a brief history of the concept in science and art to then identify the various concepts of life on which the works are based.

A glimpse into the cognitive concept of life

The idea of that which is identified as life, as *Urtopos*, has changed steadily parallel to the development of the natural sciences. At first, everything from star to stone was considered animate and living. This concept took a 180-degree turn with the mechanistic thinking of the seventeenth century. Spirit and matter were categorically separated. The materialistic perspective held its ground and thereby also the ideas of human as machine[2] and life as a purely physical phenomenon.

In both art and science, especially from the eighteenth century, an initially morphological approach and classification of the components of life occurred from a mechanistic, or iconographic perspective. In the nineteenth century one then spoke of time-based processes, such as development, inheritance, and transformation. Discovered was also a still abstruse mesh of relations of organic and inorganic factors of life.[3] Prevailing since the early twentieth century is a conception of life as codified interplay of matter, energy, and information. Based on that, life is understood as a complex system of cybernetic, thermodynamic, metabolic, cognitive, and communicative processes.

The idea of life as a self-organizing, -maintaining, -reproducing, i.e., autopoietic and cognitive process[4] was expanded once again in the twenty-first century to become a biological data processing system. From this time on, it has comprised "a mesh of biochemical and electronic algorithms without clear borders and without individual hubs."[5] This ensued from findings within cybernetics,[6] and other areas that consider information as providing the structuring power of future societies. Already before the decoding and sequencing of the human genome, Manfred Eigen (1927–2019) had discovered that information is also a molecular trait of matter.[7] Ever since, information technology has expanded beyond the digital world of computers and has penetrated the body itself more and more. Nowadays, also health and medicine are increasingly co-determined by processes of electronic data processing. The *software* of life is thus meanwhile not only controlled, but also corrected and altered.

The lowest common denominator of all approaches is that life is determined by irreversible time-based processes[8] and moreover, is characterized by fundamental instability. Stability and balance first arise the moment life ceases to exist, in death. From astrobiology, which searches for possible life in the cosmos, through to quantum biology, which searches for the same at the subatomic level, we can find a broad spectrum of possibilities for approaching the term. Considering the transforming, endless development of the definitions of "life,"[9] a potential confrontation with the question of the extent to which an artwork can embody a living system depends on the terminology that we assume. A clarification of which concept of life is at the base of each work can contribute greatly to an understanding of its significance.

Art and life

Since the beginning of its history, art has been about life. At first, the intellectual and symbolic imagination of what life is or might be merged with the mimetic rendering of its forms, colors, and materiality. An active interest in the most minute static reproduction of nature was at the forefront until well into the eighteenth century. Furthermore, at the time, the idea of artificial life in the mechanical figures of the duck, the flute player, and the drummer by Jacques de Vaucanson (1707–1782) were already extremely popular. The same can be said for the mechanical writer, drawer, and organ player by Pierre Jaquet-Droz (1721–1790).

In the Romantic period, with increasing subjectivation, the world of forms of humans, animals, and plants mixed with atmospheric depictions and expressions of inner emotions. Air, light, and movement as permeable elements of new perception principles were then also defining for Impressionism. Finally, film set the picture in motion and attempted to approach life via new narrative and development structures. In this way, for the first time the processes of instability and transformation of life could be mimetically represented at the end of the nineteenth century.

In the early twentieth century, the cubists freed art from its fixation on a central-perspective viewer orientation. The discovery and immersion in new realities of knowledge[10] led to the abstract exploration of realities, which were exhausted in various genres by Dadaists, futurists, and surrealists. These new realities could no longer be captured with the eye, but instead, were accessible via cognitive processes. Quantum physics, relativity theory, and psychoanalysis, as catalysts for artistic confrontations, were concerned with the inner structures and functions of space and time, matter and energy, psyche and mind.

Parallel to that, moving sculptures arose, animated via light, wind, and electricity. The early kinetic light and movement objects by Marcel Duchamp (1887–1968), Vladimir Tatlin (1885–1953), and Lázló Moholy-Nagy (1895–1946) already point to an increased grappling with an art that was mechanically animated using motors. In his cybernetic works in the 1950s, Nicolas Schöffer (1912–1992) further developed the elements of Constructivism and Kinetic Art to a new syncretism. Roy Ascott (*1934) defined Kinetic and Cybernetic art also as Behaviourist Art.[11] This was characterized by open

systems whose components react to the challenge of their inner composition and external surroundings, and in doing so, permanently change as a whole: “Structures that behave, that is, art forms that articulate their parts in response to the prompting of their internal and external environments.”[12] Now it is no longer simply movement and time, but more complex relations, behavioral patterns, interactions, and communication that shape the new relationship of art and life.

Art and life as process-shaped systems

In the 1960s the equating of art and life[13] was increasingly expressed politically, socially, and culturally, especially in the performative and participatory art of the Happenings and the Fluxus movement, but also in the new Body Art and Land Art movements.

Through the input of one’s own body, or the involvement of other people, animals, plants, fungi, or bacteria, art and life were meant to be identical. For example, in the growth and decay processes of meat and plants, mold and feces, and with the influence of various natural and artificial energy forms, and organic and inorganic substances. At the same time, the interfaces and border realms of art and life were constantly renegotiated and could be experienced in their transience and permanent transformation. Here, the irreversible processes of life, the time-factor inscribed in matter, represent not only the ephemeral nature of existence, but also of art. This is shown, for example, in Piero Manzoni’s (1933–1963) satirical *Merda d'artista* (1961), Daniel Spoerri’s (*1930) and Antoni Miralda’s (*1942) installations with decaying food remains, and Artur Barrio’s (*1945) *Livro de carne* (1978/79), among many other works of this period.

At times, the emerging, always hybrid forms of expression deliberately dissolved in the processes of life. New materials, dynamics of cognition, and communication of artistic creation converged in the body, in everyday life, in public space, and in the landscape. At the same time, artists liberated their works from the narrow framework —in the dual sense—of exclusivity of a closed, self-contained work concept. Their projects were increasingly characterized as open, social, political, and ecological systems, which via the creation of new interaction factors made tangible an inclusive togetherness of diverse actors. The term System Art, coined by Jack Burnham (1931–2019)[14] defines a form of expression that emerges, grows, and transforms in open fields of relations.

Also included in this at the time were artistic projects concerned with environmental themes and ecological systems. In this context, live insects, fish, and plants became a crucial component of artistic works, such as Luis Benedit's (1937–2011) series of *Microzoos* (1968) and *Biotron* (1979), or in Hans Haacke's (*1936) installation *Rhinewater Purification Plant* (1972).

In the 1970s, early computer art developed the first graphic generative systems. These were made up of modular units developed from algorithms, whose combination developed autonomously to ever more complex configurations. Arising from this were unforeseeable forms, surfaces, volumes, and behavioral patterns shaped by chance, which then moved and evolved in animations.
Following the autonomous, generative computer art systems of the 1970s and 1980s, among them the pioneering works by Louis Bec (*1936), William Latham (*1961), and Yoichiro Kawaguchi (*1952), which had an especially inspiring influence on Sommerer and Mignonneau,[15] came the interactive media art of the 1990s, which was characterized by the audience's active involvement and intervention in the development of the open artwork. In this, more than just the algorithm is decisive for the structure and function, performance and evolution of a project. The interface, the concrete intersection that connects human and machine also becomes more significant as a creative element of the work. The audience and its direct interaction with the project are likewise decisive for the random based processes, which merge with the deterministic elements. Furthermore, in many cases interaction is required so that the artwork can become visible and be experimented with. This is already evident in the early interactive works by Sommerer and Mignonneau from 1992.

Sommerer and Mignonneau

When the two artists began their collaboration, the concept of Artificial Life (AL) was in the process of forming a new research area in science and art. In 1987 Christopher Langton coined AL as "the study of man-made behaviours characteristic of natural living systems. […] By extending the empirical foundation upon which biology is based beyond the carbon-chain life that has evolved on Earth, Artificial Life can contribute to theoretical biology by locating life-as-we-know-it within the larger picture of life-as-it-could-be."[16] At the same time, the decoding of the human genome between 1990 and 2003 influenced innovative realizations related to the architecture of life, and the

interdisciplinary collaboration of formal- and natural science fields was granted new urgency.

The interdisciplinary approach of the artists' interactive installations is already reflected in their backgrounds. Before Sommerer's education at the Academy of Fine Arts in Vienna, she had studied biology, while before the two met at the Institute for New Media at the Städelschule in Frankfurt, Mignonneau had specialized in audiovisual art and programming.

Sommerer's und Mignonneau's unique, consistently newly emerging virtual landscapes and eco-systems unfurl their impact in the tension of order and chaos, programmed and unpredictable happening. They are comprised of open and performative weaves of relations of plants, insects, people, and machines, or in other words, they are interactive systems of silicon and carbon agents. At the same time, in each case, this network turns out to be a fraction of what we would define as living.

A priori, these artistic works could consequently be viewed as living systems in that all their components interact, communicate, change, and develop. At the same time, the borders of what comprises life are constantly being questioned and expanded. Therefore, it is initially irrelevant whether the various elements are artificial or organic. In the words of Lynn Margulis (1938–2011): "From a biosphere perspective, machines present one of DNA's most recent strategies for the growth, continuation, and development of ancient autopoiesis. [...] The fact that machines are reliant on humans for their construction and maintenance, does not appear to be a strong argument against their evolutionary capacity."[17]
Margulis hereby identifies the dualistic notions of human and machine, artificial and natural as anachronistic conceptual models. Among other reasons, because the Cartesian principle can no longer fulfill the demands and complexity of today's experience and knowledge creation.

Of course, the questions that have shaped all knowledge about life immediately arise here: where does it start and where are its borders? Where exactly can we locate the intersection between organic and artificial life, or between open and closed systems?

In this context, we should be aware that the instruments with which Sommerer and Mignonneau work, are based on technologies using quantum mechanics. The entire area of digital electronics rests on knowledge from quantum physics. Here, the distinction is no longer the bipolarity of *either–or*. The world of the smallest particles is instead one of *both/and*. The latter corresponds with Werner Heisenberg's (1901–1976) uncertainty principle and Nils Bohr's (1885–1962) complementarity principle, as well as the quantum physicist Erwin Schrödinger (1887–1961)'s conceptual model of the simultaneously living and dead cat.[18]

Schrödinger held his much discussed lecture series on this, "What is life?" at Trinity College Dublin in the 1940s. However, he was not concerned with systematic and developmental history relations. Instead, he was interested in the microcosm of the cells and their subatomic interactions: everything that characterizes and holds together not the world, but the living organism in its innermost realms.

Other physicists and mathematicians also carried out interesting projects on the theme of life beginning in the 1940s. John von Neumann (1903–1957) developed the theory of the self-reproducing automata in 1953. It contributed to both the development of artificial intelligence in the 1950s as well as to the AL discourse in the 1980s.

In *The Game of Life,* John Horton Conway (1937–2020) programmed one of the first mathematically calculable simulations of life in 1970. His two-dimensional cellular automaton, which mimicked the behavior, development, and variability of the microcosmos of life, inspired in its day, the theoretical biologist Christopher Langton (*1949). In 1986, Langton's two-dimensional ant Turing machine likewise used simple rules to lay out the development of ordered structures that evolve to chaotic-complex systems. Both made the development from simple pattern to complex behavior visible and calculable.

The sum of these pioneering findings in physics, mathematics, and AL research testify to the discursive inconclusiveness of the *Urtopos* of life, which denies any finalization of its definition. At the same time, life is the permanently present primal matrix for everything that has ever been and will be studied. The ambiguity of an all-determining presence and simultaneous denial of a logically understandable final definition is

tangible in the interactive installations of the two artists, also for those visitors who know nothing of quantum mechanical, mathematical, or biological cutting-edge experiments. After all, the power of Sommerer's and Mignonneau's works becomes manifest in the AL environment, not only in its virtual dimension, but also in an integral, haptic sensual presence. The two artists employ AL as both purpose and means—as an instrument for an expanded comprehension of what life is or can be.

The artists do not employ virtuality as an adversary of reality. Instead, they understand virtuality as an elementary factor of what, since the quantum physics of nature, has corresponded with the smallest particle. Thus, Heisenberg's student, Hans-Peter Dürr (1929–2014), says: "Instead of the world assumed until then, a mechanistic, thing-filled, temporally determined 'reality' (Latin res = thing), the actual *Wirklichkeit* (a world that 'wirkt', that effects or affects!) turned out to be 'potentiality': an indivisible, immaterial, temporally essentially undetermined network of relationships that determines only probabilities, differentiated capacity (potency) for a material-energetic realization."[19] Dürr goes on to explain, "The classical 'reality' of material/object-like separated things emerges only through a coarsening averaging of the potential, thus turns into a holistic, temporally essentially open, immaterial, inseparable omni-connectedness."[20]

1) **Potentiality**

At the forefront of all Sommerer's and Mignonneau's projects is the performative process of potential emergence and decay. In this, five work groups can be differentiated, which at times also overlap. The first work group, between 1992 and 1996, grapples with what David Bohm (1917–1992) describes as the existence of inherent potentiality.[21]

Belonging to this work group are, among others, *Interactive Plant Growing* (1992), *A-Volve* (1996), *Phototropy* (1994), and *Eau de Jardin* (2004).

The experience of *both/and* of the potentially possible was already clearly expressed in *Interactive Plant Growing* in 1992. While the visitors intuitively let their hands stroke each of the real plants, a virtual landscape arose before them. This comprised precisely those digital forms that correspond with the organic fern, cactus, ivy, a small tree, or moss, that they had just touched.

The visitors' interaction with the real vegetation determines growth and transformation of the digital nature. The movement and electromagnetic signals of the hand nourish the system with energy and information. This becomes manifest in continually newly developing volumes and movements of virtual worlds on the installation's projection surface.

In the physical world, growth and transformation take place in space-time dimensions that the human senses cannot always perceive directly. The algorithms of the digital environment, however, form a common denominator, which makes the space-time scales perceptible at one and the same level. In this, the processes inherent to life, some of which are extremely slow, become visible and sensually tangible. The interacting audience likewise experiences itself consciously as an active part of the totality of a living system. And just as every single element of the whole also influences the environment, the development of each part is shaped by the totality of the system. All of this can be comprehended in artificial as well as natural, and digital as well as real environments.
In contrast to *Interactive Plant Growing* (1992), *Phototrophy* (1994) concentrates on the role of light as a live-giving and simultaneously destructive factor. Light is the element of a metabolic circulation that connects the macroscopic levels of the solar system with the microscopic dimension of living cells. In Sommerer's and Mignonneau's interactive installation, the source of light consists of the electromagnetic beams of a flashlight, which allow artificial life to arise on a projection surface, "nourish", move, and reproduce it. Depending on the audience's interaction, the same nourishing light can also prove to be destructive and lethal, in that it burns the life that has been created.

In *A-Volve* (1996), the relationship of form, movement, and behavior and the interplay of deterministic and aleatoric elements are not all that is decisive for the development of artificial worlds. Concretely, at issue is mutation, hereditary transmission, and competence among artificial living beings, but also communication among humans, machines, and artificial creatures.
In addition, this work deals with the moment that life begins. It tries to answer the question of what existed first: the function or the information (the chicken or the egg). In *A-Volve*, the artists solved this paradox artistically. The moment viewers place their fingers on a touchscreen and let them glide over the smooth surface, the movement and

sign become gestalt. Thus, first the movement, i.e., function, and then the gestalt, i.e., the body, that is (in)formation.
The sign arising on the flatscreen, in turn, is "nourished" or processed by the computer system until it evolves into a three-dimensional being whose behavior is determined by its own (in)formation.
In the virtual world of A-Volve ~~(1996)~~, also the digital organisms' functions of reproduction, growth, mutation, and lifespan are algorithmically predetermined. However, here, too, their final development depends on the public's aleatoric interaction. For example, the public's direct attention and gestures with respect to each individual organism influence the organisms' development and lifespan just as much as their mutual communicative and competence behavior among themselves.
In *Eau de Jardin*, water is ultimately introduced as a life-giving and maintaining element.

2) **Communication**
In a second work group of AL installations, Sommerer and Mignonneau investigated the relationship of life and communication. Beginning with *GENMA* (1996) it extends to *Life Writer* (2006). The group is inspired by Noam Chomsky's (*1928) biolinguistics. Already in the 1950s, Chomsky attempted to trace the origins of language from genetic code through to cultural means of expression. Representative of that in this retrospective is the project *Life Spacies II* (1999).

Sommerer and Mignonneau have recreated this idea of language development in a series of works in which the four chemical bases of organic compounds are each translated into a binary code. The changing order of signs, for its part, corresponds with the twenty-six letters of the alphabet.
As is generally known, in terms of its genetic assembly, life is composed of just four different nucleotide bases (letters), or chemical units: adenine, guanine, thymine, and cytosine. In the double helix, nonetheless, the only possible pairings are A with T and G with C. What differentiates one organism from another is the total number and sequence of the chemical units in each of the DNA molecules.

The audience, whether internet-based or site-specific at an installation in an exhibition space, has access to a system that transforms the words and sentences that the visitors

write on a laptop into the DNA of artificial organisms. Their shape, color, and movement result from the translation of the symbolic language of writing into the mathematical language of the algorithm, and simultaneously into the artificial creatures' genetic codes.

Even when the building blocks of life predetermine the existence of these artificial organisms, here, too, the free interplay between determinism and indetermination is precisely the factor that influences becoming, growth, mutation, and reproduction of the artificial organisms.
Norbert Wiener describes life as a structurally closed form and functionally open system from the perspective of homeostasis, "We are but whirlpools in a river of ever-flowing water. We are not stuff that abides, but patterns that perpetuate themselves."[22]
In the experimental interaction, the users of the artistic works can directly experience this unity despite constant changes.

3) **Environments**
Whereas until now the time-conditioned process of life was at the foreground of the receptive experience of works, the installations of the third group focus more on the spatial dimension of life. Between 1999 and 2010 Sommerer and Mignonneau led us from the molecular dimension of life into the macroscopic world of existence. *Haze Express* (1999) comprises a large flat screen, which like the window of a fast train lets us schematically recognize the passing landscape. This landscape changes its shape depending on the speed of the hypothetical means of transport, which users can accelerate or decelerate with a light press of the hand on the flat screen.
The interactive installation emphatically shows the changes in the perception and shape of our environment in the digitally networked world.

The work arose just ten years after the invention of the *World Wide Web*. The internet had a revolutionary effect on the globalization of the environment, similar to the impact of trains and networked transportation systems on regional and national environments at the start of the nineteenth century. Referring to this, *Haze Express* (1999) recalls William Turner's (1775–1851) well-known painting *Rain, Steam and Speed – The Great Western Railway* (1844), likewise characterized by a landscape arising from the

mist and new visual and physical experiences based on technological progress. The theme of the industrial-revolution shaped environment is subsequently intensified in the interactive installation *Industrial Evolution* (2000). Works such as *Riding the Net* (2000), *The Living Room* (2001), and *The Living Web* (2002) then proceed to make comprehensible and tangible the digital revolution's implications for our everyday awareness.

4) **Interface**

Sommerer's und Mignonneau's fourth workgroup, from *NanoScape* (2002) to *Between the Lines* (2014), is characterized by innovative interface development.

For their interactive installations, the artists develop new interfaces, new communication connections between the most minute nanometric processes and the human body.

For this, mainly traditional media—such as an old typewriter, a radio device, a ballpoint pen, or a mobile phone—are converted to digital interfaces. They mediate information between the various scales of existence that remain inaccessible to human perception. *NanoScape* (2002), for example, lets the audience directly perceive subatomic processes, which without digital technology, are neither haptically nor visually perceptible by the human body. *Mobile Feeling* (2003) transfers biometric data, such as heartbeat and pulse, between the individual mobile telephones of the users. Via a camera tracking system, *The Value of Art* (2010) connects how much attention viewers give to an image with a computer system. This, in turn, translates the qualitative data of attention into quantitative factors of market value.

Altogether, the artists employ interface design as an intersection of various levels of reality. In this way, they enable and design a communication process between genetic codes, mathematical algorithms, semantic sign systems, and the recipients' bodies. Their works thereby point to the significance of the development of innovative interfaces in knowledge production, to allow the various codes of life to enter into a relationship that is perceptible, and in the truest sense of the word tangible for users.

How crucial interface design can be for a more comprehensive understanding of living systems is evident in the most recent findings from the interdisciplinary research field of biocommunication. It examines the information exchange within and between various cells, organs, and between the same, related, and different species. As Günther Witzany

(*1953) explains, made obvious by this is “that cells, tissues, organs, and organisms coordinate and organize by means of communicative processes.” He also emphasizes, “that the arrangement of the genetic nucleotide sequences in cellular and non-cellular (viral) genomes is linguistically structured and follows combinatorial (syntactic), context-sensitive (pragmatic) and content-specific (semantic) rules.”[23]

5) **Symbiotic coexistence: cooperation rather than competition**

In terms of biological organisms, in the eighteenth century, classical taxonomy initially differentiated only between plants and animals.[24] In the mid-twentieth century came a distinction between five different kingdoms:[25] that of the living beings with a cell nucleus, Plantae and Animalia and Fungi, and those without a cell nucleus, Protista, i.e., algae and protozoa; and Monera or prokaryotes, i.e., archaea and bacteria. More recent taxonomies are already dealing with seven realms.[26] The latest research findings allow for estimates according to which the human is comprised of approximately thirty billion eucaryotes and roughly thirty-nine billion bacteria on or in the body.[27] Precisely this, puts to question the once again traditional idea of human biological identity and ultimately influences also philosophical questions of identity.

The most recent and fifth workgroup focuses precisely on this theme. In doing so, becoming visible and tangible are new concepts of a “self” that is made up of a multitude and diversity of microscopic beings.
Here, however, it is not bacteria but flies that determine the digital image of viewers portrayed by Sommerer’s und Mignonneau’s AL system. Whether bacteria or flies is irrelevant; visualized in the entire workgroup in various ways is that the biological identity of the “self” can always only be a “we.”

Portraits on the Fly (2015) begins with a series of interactive images. For this, the individual facial features, or silhouettes of the audience, are formed by virtual flies, which can be chased from the digital image of the flatscreen with a slight hand or body movement, but which continually lie like a dark shadow on our portrayed appearance as soon as we stand still in front of the digital mirror of the AL system.

Altogether, the “we” as a collective being can meet the challenges of, that is, survive the current environmental problems only when it foregrounds cooperation. Lynn Margulis

already stated this early on: “Life did not take over the world by combat, but by networking.”[28] Contradicting the Neo-Darwinists, after many years of researching symbiotic interactions between various microorganisms, she arrived at a realization, which already in the 1970s, provided new impulses for the theory of symbiogenesis. Complementary to the theory of evolution, symbiogenesis derives the emergence and development of new life forms from the long-term cooperation and ultimate merging of separate microorganisms to new endosymbiotic units. Accordingly, the human would now also be an endosymbiotic organism.

Conclusion

Interesting in our context is, in conclusion, the claim by Margulis, that the world of machines was not created exclusively by and for humans, as “even before Homosapiens existed, the manipulation of minerals and the drafting of artificial constructions was developed by the beings with whom we share this planet.”[29] When we take this cooperative factor of evolutionary history even further, then also Donna Haraway’s statement gains new significance: “Late twentieth-century machines have made thoroughly ambiguous the differences between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines. Our machines are disturbingly lively, and we ourselves frighteningly inert.”[30]

In Christa Sommerer’s and Laurent Mignonneau’s works, exactly this can be haptically, visually, and performatively experienced. Their works are a challenge to our ideas and knowledge of life. Furthermore, they are a provocation and reference to the importance of directing new attention to the life in us and around us. Both that which is written in capital letters manifests itself physically as material life, as well as what in small letters understoods itself as action and process.

In the current, open realms of experience and cognition of life, the question of the artwork as a living system is answered at the level of quantum physics’ *both/and*. To the extent that in Sommerer’s and Mignonneau’s projects, life consists of not only carbon-based organisms, but also silicon-based processes. For decades, silicon has been a core component of the microchip and thereby of all software development at the base of Sommerer’s and Mignonneau’s interactive installations.

The Miller-Uray experiment in 1953 provided the first hint that biological molecules can form from inorganic substances. In the same year, Francis Crick (1916–2004) and James Watson (*1928) published their discovery of DNA's double helix. It is therefore obvious that another few billion years would have to pass before a hypothetical potential connection of carbon and silicon would make new forms and processes of life possible.

Art, science, and technology have undoubtedly opened the door to the world of new forms and processes of life. The continuous work by Sommerer and Mignonneau takes a further step into the present of the future. Their works allow us to comprehend the tangible, perceptible understanding, the virtuality of the potentially possible, as an essential component of living systems. The retrospective is thereby an invitation to submerge in precisely these spheres of an open-ended development, to perceive them and in the dual sense of the word, grasp and experiment them. In the end, the users are also an active part of what could be the future evolution and shaping of life. As, to conclude here in the words of Wiener: "We know that for a long time everything we do will be nothing more than the jumping off point for those who have the advantage of already being aware of our ultimate results."[31]

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