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10. Coreless. Bacteria, art, and other incommodities

10.1 Big bacteria: a future framework for the arts, sciences and humanities[1]

10.1.1 Preliminary

Being the oldest, smallest, most abundant and structurally simplest organisms, bacteria are ubiquitous, diverse and variant, as well as vital for all other life forms. Bacteria's materiality, aliveness and invisibility challenge recent visual and representational explanation patterns. This most primitive cell exhibits a form of organisation that is responsible for interpreting and changing the processes it is involved in. As such, bacteria cannot be completely captured neither in the concept of representation nor in that of information. The methodological efforts to overcome the crisis of scriptural representation "*have been building up steam since the post-modern era and the turn to the sensory dimension in the 1980's.*" (Zilberg 2012, p. 18.) The simultaneous rise of the research of visual representation and the bodily experience comprise the cornerstones, marking the edges of a wide field which covers the invisible but living matter, agents or acteurs and affects us no less than the mass and social or cellular media coverage. Throughout the previous decades, the paradigmatic-genealogical oriented methodological perspectives have determined bacteria either *in toto* or as models which represent human agencies, societies or ecological systems, so going *beyond* bacteria's quantity, qualities, relations and modalities.[2] At the same time, emerging sub disciplines of the life sciences. like synthetic biology interpret bacteria mainly as media and material ('bio-bricks'[3]) or as breeding-containers for sub-cellular processes, so going *below* the necessary requirements of these basic organisms.[4]

The purpose of the forming of Big Bacteria research network is to examine both the abovementioned impasses and bacteria's fundamental features that make them the basic media, tools and agents of living matter. The aim is to understand when, where, why and how bacteria has served and increasingly serve as omnipresent motives, metaphors and models for rethinking relations between natural and health sciences, the humanities and the arts, by building not least on the recent results of international interdisciplinary research.[5]

10.1.2 The central hypothesis

The central hypothesis and the concept is represented by the methodological and content structure of the network with the purpose of enabling an effective interdisciplinary collaboration on concrete sub-projects while remaining clearly arranged and controllable with respect to their outcomes. Big Bacteria's central hypothesis is that interdisciplinary inquiry in bacteria's quantity, qualities, relations and modalities provides an overall potential to boost corresponding research with an immense variety of societal and industrial applications. Bacteria are therefore to be methodologically treated as (a) indispensable matter of knowledge (*bacteria as epistemic objects*, material and media) and as (b) methods for its acquiring (*bacteria as epistemic tools* for analysis and synthesis), as well as (c) agents and agencies (*bacteria as epistemic subjects* of historicising and experimentation).

10.1.3 Bacteria as Epistemic Subjects, Objects and Tools

Big Bacteria	1 Agency	2 Form & Growth	3 Size & Sensing	4 Diversity	5 Productivity
A Epistemic Objects (Material & Media)	Dust as Matter & Medium in Environmental Research	Patina & Bio Film in Preservation of Heritage and Environment	Classifying Cultures: Bacterial Taxonomy & Mediality	Bacteria's Metabolic Diversity	Health & Wealth: Microbial Ecology and Sociality
B Epistemic Tools (Analysis & Synthesis)	Bacterium and Cell: Autonomous Agents, Acteurs & Information	Epistemic Twists: Motility & Adherence	System Models & Behavioural Patterns	Bacteria's Variation Diversity: Mutation & Recombination	Duplicity: Bacteriology and Synthetic Biology
C Epistemis Subjects (Historicizing & Experimentation)	*Res vivens*: The Discursive Fields of Life	Bacteria's Structures & Visualization	Epidemic Twists: Germ Theory of Disease	Bacteria Tweaking in Contemporary Culture	Between Lab and Field Research: Bacteria's Etiology & Evolution

Big Bacteria's hypothesis and central concept bound into the net of the methodological divergences (A–C) and content convergences (1–5)[6], related to the research questions

A. Bacteria as epistemic objects

[A1] As a matter of fact, bacteria are the basis of permanently changing and sensing living matter. Microbial 'dust'[7] and 'patina' (Toyka 1996, Krumbein 2003, Gorbushina et. al. 2000) as material and medium represent an important case for bacteria's agency to be systematised. [A2] While the related research on bioremediation (Lovley 2001, Wassenaar 2012 et. al.) and biodeterioration[8] is already used in artistic and scientific attempts to protect world heritage. [A3] To sense and comprehend the nature and the cultures of bacteria and microbial biofilms means to learn to sense and comprehend ourselves within our world in a more profound manner. The Danish botanist and medicine professor of Copenhagen University, Hans Ch. Gram (1853–1938) brought about a still valid pre-molecular approach by staining bacteria (*Gram Stain*), which served as the first step in the identification of a bacterial organism and a valuable diagnostic tool in both the clinical and research environment. The method relies on different colour staining of gram-positive and gram-negative bacteria, depending on the physical differences of their cell walls, while this epistemologically fruitful dichotomy is being aesthetically implemented. The new and emerging methods of phylogenetics, cladistics and systematics of bacteria follow the molecular approach[9] of their identification, characterisation and nomenclature in different strands with the purpose of integrating genomics with taxonomy and systematics.[10] With respect to the thousands (if not hundreds of thousands) of uncharacterised type strains of bacterial species with validly published names (by April 2014 there are ca. 2.300 valid bacterial names listed), it is clear that the future taxonomy as well as other fields of microbiology, including ecology and clinical microbiology, rely on such results. At the same time, both the major classifying cultures are bringing about new bacteria species as epistemic objects by naming them, although most of them are not known to exist outside the laboratory. An interdisciplinary look at the preceding and molecular approaches to this rapidly changing ontology is required to understand existing and emerging requirements for redefining genomes and living matter for responding to the urgent requests. [A4] As irreplaceable components of recycled matter, bacteria deserve this nomination first and foremost due to their metabolic diversity, enabling them to obtain carbon atoms and energy from practically everywhere on Earth. This diverse feature, seen by many as the true nature of bacteria, makes them the real synonym of ubiquity, which is yet to be mapped in detail. [A5] In spite of the serious diseases which specific bacteria species bring about (tuberculosis, typhoid, tetanus, dysentery, influenza, diphtheria, pneumonia, cholera, blood poisoning, syphilis, gonorrhoea, plague, anthrax), the study of the economic importance of bacteria clearly indicates that the beneficial aspects of bacteria prevail and require an appropriate elucidation and an advanced educative approach and inclusion in the curricula.[11] The material and medial, synthetic and analytic as well as experimenting and historicising aspects of the protection and productivity brought by bacteria represent the global needs that can be adjusted on local level. The profound impact of bacteria on the world's ecology (being a precondition for life) brings about the urgent need for interdisciplinary research at the intersection of health and wealth. Finally, microbial ecology and sociality are stacked together in the rather cursorily described phenomena of bacterial 'suspended animation' in form of spores or 'dormant bacteria'. The former concepts of pleomorphismus of micro organisms and other hypotheses supported by the optically observed endosymbiotic life forms inside the cells (cf. dark field microscopy after G. Enderlein) require further inquiries and systematisations of both the beneficial and pathogen impacts of the bacteria.

B. Bacteria as epistemic tools

[B1] Analytical and synthetic research approaches and explanation patterns to the bacterium and cell reveal the long-standing methodological and practical tensions between the concepts of life and autonomous agents (Kauffman 2004, Bedau 2007), acteurs and the concept of information. (Schrödinger 1951, Wilson 2001) Bacteria as one-cell organisms are described from the biosemiotic perspective as the simplest natural cases of an observing system (Hoffmeyer, Pattee), which makes them not only an interpretation instance, but also leaves room for questioning how our habits represent the most general forms of interpretation. (Hoffmeyer 1998) At the same time, the accompanying concept of 'iconic absence' (Hoffmeyer), challenges the concept of representation, pointing out the related, long-standing epistemic and ontological issues related to the definition of life. The latter converges with the abovementioned concepts in the dispute between the cybernetic suggestions related to artificial life and those of general biology (Kauffman), geology and marine biology (Krummbein, Gorbushina, Caneva, Gram), as well as the biosemiotic (Hoffmeyer et. al.) [B2] The knowledge about the adherence and motility of bacteria, their magnitude and the internal form and structure of cells, has potential to feed beneficial interdisciplinary insights back into the early diagnosis via dark field microscopy (both analogue and electronic). A very simple yet effective technique, it is well suited for analysis of live and unstained single-celled organisms. More general morphological questions (*karyokinesis*) (Thompson 1917, p. 23ff.) provide further interdisciplinary openings both of and for synthetic approaches.[12] [B3] At the interconnection between their size and sense, bacterial interactions provide us with models of social behaviour (*quorum sensing*)[13] which make it unavoidable to acknowledge the underlying constructivism in the bacterial taxonomy. [B4] Since bacteria's rapid mutation-capacity is followed by an offensive use of recombination techniques to provide an immediate reaction in the globalised context, the clearly recognised, labour-induced (multiple-) resistance problem of lethal bacteria requires adjustments of strategies and deeper interdisciplinary reflection as well. (Blaser 2014. Cf. Schmitt 1982 and recent research in MRSA/ORSA.) Both analytical and synthetic approaches should be put respectively in an interdisciplinary perspective. [B5] Micro organisms have also been increasingly central in philosophy and art. (Cf. Kauffman, Latour, Pattee, Peirce, Hoffmeyer, Schrödinger, Leduc, Thompson)

C. Bacteria as epistemic subjects

[C1] In respect to both the historicising and the experimental approaches to life at its most basic level – the one cellular life of bacteria – competing requirements of life for a microbe exist, and as such serve as 'container' or breeding medium directly meeting the needs of synthetic biology or other applications of molecular biology. Historicising of the discursive fields of life as *res vivens* and the problem of agency offers, therefore, further profound cultural-historical and anthropological insights into the philosophical, epistemic and medicinal questions related to bacteria and microbial research.[14] Today we are engaged with life that both juristically and economically seems to be indestructible and is therefore dealt with as exchangeable, patentable, recombinable and saleable. The increasingly perfect closed-circuit technologies for visualisation, data acquisition and control (Cf. Bogard 1996, Kacunko 2004 & 2010) are providing us with constant images of such life, while its visual coverage and adequate capturing is being challenged by the fluid features and modifying survival strategies of the 'subject matter'. This innate permeability and capability of the cohesion of bacteria as epistemic objects, which can also serve as subjects, agents or instruments of understanding, are of particular interest here. Bacteria mark the identity-difference of animated matter and fill the philosophical gap between the *res cogitans* and *res extensa*. As *res vivens*,[15] these coreless one-cell organisms build today's dominant core media and materials of art and science projects involving biotechnologies. They are also emblematic of how much biological research has always been dependent on the very representation of its objects of analysis and findings, as the abovementioned method of staining bacteria (Gram Stain) clearly demonstrates. Considering that "*map making is world making*" (Nelson Goodman, *Ways of Worldmaking*, 1978), bacteria have been overlooked as subject matter since their adaptive mediality and in-betweeness is not prone to the ontological construction of subjectivity. And yet, current initiatives such as the Human Microbiome Project explore the fact that the human body contains over ten times more microbial cells than human cells, epistemologically turning individual organisms into symbiotic ecological communities. [C2] Bacteria's structural simplicity (three basic forms of bacilli, cocci and spirilla) and the possibility as well as strategies of their visualisation (for example of peptidoglycan which serves a structural role in the bacterial cell wall, giving it both a structural strength and counteracting the osmotic pressure of the cytoplasm) still belong to the most interesting epistemic and aesthetic problems which I tend to summarise under the label of infinitesimal aesthetic. Both the stained and not-stained bacteria (the latter visually 'captured' in movement), as well as less known analogue and digital microscopic techniques, belong to this research question. [C3] The historiography and the experimental and medical praxis, art and literature deliver the best documented (if not interpreted in-depth) field, on which the centuries of epidemic twists must be projected. The genealogy and the dialectic between miasma theory and humoral[16] theory of immunity on one side and the contagion, cellular or germ theory of infection on the other, became problematic nearly ten years ago from the perspective of the sociological history of science. (Cf. Sarasin et. al. 2007) However, the relationship of bacteria as agents and 'acteurs' (Latour 2007), both in their concrete applications and appearances today and outside of the disease and epidemiology context, remained a desideratum. [C4] The still underdeveloped praxis of bacteria tweaking in contemporary culture (tweaks are any small modifications intended to improve a system) require – for either of the abovementioned contexts – further innovative educational and implementation formats, particularly in the context of the relatively recent phenomena of 'bio-garages'. [C5] Even if we have learned most about bacteria from studies in the laboratory, it remains important to understand and further explore the limits of both the experimental and historical approach. Also the advantages and limitations of the field studies (palaeontology, fossil stromatolites et. al.) (cf. Lesch & Zaun 2010) suggest the need for case studies placed between the analogue cultured and digitally modelled results on the surface of bacterial diversity.

10.1.4 A personal retro-perspective

My first attempt to make the methods of art history, pedagogy and philosophical inquiry productive for the 'liveness' of the processual arts has resulted in a dissertation about the concepts, performances, installations and video tapes of a German artist (first in Germany, 1999), followed by another monographs (2001a,b) which finally lead to a global overview of the closed-circuit video installations (2004). From my discoveries in content-related relationships, a particular interest in systems models and behavioural patterns (including the study of physical, biological and anthropological systems) has emerged. Further inquiry can appropriately been teased with the title 'From live art to life art'. Seen through the disciplinary glasses, it became clear that the actual sciences are operating between the mechanisation of living and the animation of technology (2014i; 2012c,d; 2011b,c,e; 2010d,e; cf. Hauser 2013). The term 'technoscience' (Latour, Haraway et. al.; cf. fig. 2) describes quite accurately this transformation in which the degree of equality of human and nonhuman actors has apparently transformed the alleged polarity between the humanities and natural sciences. In the context of the emerging interdisciplinary discourse, the abovementioned comprehensive historical and theoretical review (2004) was placed (cf. Weber 2003, Hauser 2003, Reichle 2005, Whitelaw 2005).[17] Because the differences that observers register (and we measure) are heavily dictated by biologically and culturally created interests, an ethological (behaviour-oriented) approach delivered an important link in a chain of disciplines, providing a truly interdisciplinary perspective on the phenomena in question (2010). The immersions and reflections of the invisible and the concept of 'infinitesimal aesthetics' (2014c; 2012a,b,c,d; 2010a,b,c; 2009a,b) on the crossroads of biosemiotics, biotechnology, art and culture revealed not least that there are common points of departure generated out of the 'pitiless beauty' of bacterial art – a research field where substantial qualities of bacteria linked among others to light, colours and social behaviour have been explored over the past 10 years in collaboration with the artists working in this domain (2014a,b,e; 2013c). The neologism 'bacteria art' was used for the first time for the research-based art by Sabine Kacunko, who, in the context of her art and science projects, had the opportunity to work with geomicrobiologists, immunologists and cultural and natural heritage organisations like UNESCO and ICOMOS. This work has brought about further unpredicted insights and revealed the urgency of building an international interdisciplinary team and network which is hoped to be operational very soon.

In order to build the interdisciplinary team and network, an initiative project team (IPT) is being formed which consists of the internationally renowned, leading or pioneering research leaders from the fields of natural and health sciences as well as humanities including participants in other R&D excellence centres in Denmark, Germany and USA. They should be supported by the expertise of the wider research network of authors which build the core of the present state of the art knowledge in the field.[18] The hypothesis and central concept presented above include important elements of the disciplinarily dispersed knowledge on the subject matter in order to demonstrate the urgent need for interdisciplinary actualisation and systematisation. IPT's individual research results indicate that the understanding of the specialised nature sciences (like that of bacteriology) plays as significant role for the humanities, cultures and societies as the latter play for the former. (Zilberg 2011 & 2012, Ursyn 2012, Elkins 2008)

The methodological specificities of the (natural) sciences and (cultural) humanities, as well as the changing and remaining issues of collaborative productivity, have been addressed as ever with miscellaneous rhetoric and strategic points of departure, pointing out rightly that the need for an interdisciplinary curriculum development in the arts, sciences and humanities represents one of the major challenges.[19] However, collaborative potential at the research level and especially the power of artists to change the perspectives of the scientists don't seem to be encouraging. (Pepperell 2011, p. 268.) Conclusions from to the USA seem to confirm the earlier outcome of the Welcome Trust's Sciart Programme in the UK (1996–2006), expressing the conviction that basic scientific principles of verifiability and falsifiability of 'data' and 'nature of data' should not be compromised by collaborations with non-scientists. (Zilberg 2012, p.18.) The practical answers to these existing methodological challenges and confinements are included in the above-described BB's hypothesis and central concept. The 'implicit' or ideal observation and observer (like the reception aesthetics in linguistics [W. Isser] or art history [W. Kemp] use them) must therefore be replaced by an 'explicit' observer and the practice of observation, where 'immersion' and 'reflection' are no longer opposed to each other thereby opening the observation and appraisal praxis to the recent international research which also includes non-human agencies. The cell, which performs this task of bringing about the epistemic object by interpreting it – the embryonic reading of the chromosome – thus appears as "*the simplest natural case of an observing system.*" (Pattee 1996, cf. Hoffmeyer 1998) From this perspective, the vitalistic concept of an observer on one side and the calculatory concept of measurement on the other – both epistemic concepts – meet in the concept of the interpreter as both subject and object (as observer in original Greek meaning of the word θεωρία). From this 'micro human'-perspective (Kacunko 2012) in the time of the alleged 'anthropocene', the extension of research from the aetiology of art onto the aetiology of life also opens a corresponding perspective to the birth, life, death and 'resurrection' of life sciences within the context of the humanities. The following artists, working both within and outside the label 'Bio Art', belong to the international art-based research circle to be linked to the Big Bacteria network: Eduardo Kac, Edgar Lissel, Critical Art Ensemble, Adam Brown, Joe Davis, Marc Quinn, Wim Delvoye, Thomas Feuerstein, Tuur Van Balen, Anna Dumitriu, Andy Gracie, Marc Dusseiller, Yashas Shetty, Mukund Thattai, Paul Vanouse, Marta de Menezes, Peta Clancy, Andre Brodyk, Julien Haye, SymbioticA, Oron Catts, Karen D. Thornton, David Kremer, Francois-Joseph Lapointe, Gjino Šutić, Erich Schopf, Sabine Kacunko.

IPT is supposed to guarantee the programme's impact and implementation through the building and coordination of a related international network. Not least because of the significant diversity of languages between the humanities and sciences, one of the critical constructing areas of the network is the analytical, historical and communicative aspect of dealing with the acquired data and information.

10.2 Life, death and dusty rebirth: bacterial circuits and infinitesimal aesthetics

To ask for the origins of life is to ask for the origin of the environment
Jesper Hoffmeyer (1998)

The origin of the here represented, initially art-historical, interest in this area was delivered, on the one hand, by the early monographic works on video and media art (2001), which have ultimately led to a global, historical mapping of Closed Circuit video installations (2004). In one of the central research fields, out of the six content-wise elucidated ones there, the field of 'system models and behavioural patterns', the focus has moved more and more away from ontological questions to epistemological questions and from information theories to bio-epistemologies. Subsequently, as mentioned, the neologism 'bacteria art' has been applied for the first time to Sabine Kacunko's research-based art. The reason for this was the fact that the artist demonstrated an extensive understanding about the role and meaning of bacteria and biofilm in a series of exhibitions and public actions. Furthermore, her top priority was to convey the respective contents by presenting her work deliberately to as wide an audience as possible, which was virtually confronted with the term bio-art (in the sense of the art identified with lab-art in some places). It was from this perspective that the uniqueness of this approach became clear, i.e., that the artist set herself apart from most of the representatives of so-called bio-art. Approximately two-thirds of the latter has worked either randomly or on several occasions with bacteria. (cf. 10.1.3.) However, none of them, as far as I can recognize, has placed the amplitude and meaning of ubiquitous application fields of bacteria at the centre of medial public with such a programmatic consistency.[20]

Sabine Kacunko resorts in her bacteria art, amongst others, to the patina and biofilm as evidence of surface changes, which she also makes accessible for art using natural-scientific and medial methods. The goal of this article is to introduce the interdisciplinary and also media-pedagogic potentials of the respective

Figure 97: Sabine Kacunko, *Negative of the wild boar skull populated by with bacteria*. Kunstverein Coburg 2003 © Sabine Kacunko

research field, which has been so far insufficiently contextualized. The interest in bacteria so far can be most clearly conveyed through the related research-based art. The former should be illustrated using an artistic position, which has consciously made the amplitude of the mentioned research field to its own, continuous program. The currently globally spread, academic programs on art-based research (*Art-based Research*; *Practice-based Research* etc.) have researched the linkages between research through art, research about art and research that uses art. This cross-disciplinary, art-based research is defined, on the one hand, by the systematic usage of artistic processes as sources for comprehension and conveying of experiences by researchers, institutions and the audience. On the other hand, it delivers insights into the cross-disciplinary, epistemic twists, which, in turn, represent a high relevance for future education and professional practice.

If one intends to search for formative lessons and experiences about the 'bacteria art'[21] by Sabine Kacunko, one is forced to leaf through the books of her intensive school subjects, biology and religion. She gained her confidence to sail between Scylla and Charybdis of the religion and natural sciences by diving into the basics of the cell biology, molecular biology and the emerging ecology. The reactivity of microbes and other organic substances to their environment and, above all, the structure, the metabolism and the ecology of bacteria in reference to the energy cycle and cycle of materials have repeatedly been a subject of her artistic interest. In densely written notebooks the natural science specific topics can be found ranging from the general organisation of the bacterial cell and chemical reactions of species of bacteria to Micrococcus, Thiobacillus and 'jumping genes' on bacterial plasmids. (Schmitt 1982, p.139–ff.) They also contain notes about antibiotic resistances and corresponding 'natural monuments'.[22]

With the bacteria art by Sabine Kacunko in mind, alleged contradictions come undone even more naturally and without theoretical constraint when biology, the life science, is regarded as a fringe science *par excellence*. Art as fringe science and bearer of 'interface aesthetics' implies in this context, the apparently creative and interpretative basics of the natural sciences and refers to the general macro connections between art and science that continuously reform and transform themselves especially on the micro-level. In retrospect, it becomes evident how the 'fringe arts' and 'fringe sciences' found their medium in bacteria art, after the early interpenetration of biology and religion left the historical background to find a new context. The alchemy, operating preferably in the shadows, of this procreative and at the same time highly explosive mixture became the common working method of the graduate from the Düsseldorf Arts Academy in the 1990s, when she created extreme close-up pictures of still life (in this case literally *nature morte*) by dint of daylight and thus revealed a fascinating, meaningful and important transformation. This transformation finally resulted in the bacteria art in the 2000s.

The (self-) appreciation of the individual artistic vision became more important during the ensuing period, especially along the interface between art and technology, biology and geology. The 'truth' – as ancient Greek *a-leteia* or un-concealment – manifested itself as a mission that the most famous German visionary of the Middle Ages, Hildegard von Bingen, described memorably as: "*You have the task to reveal the concealed things.*" With her closed-circuit video installation *Product of Life* (2002),[23] Sabine Kacunko finishes probably the 'highest ranking' theme circle of her art; the circle in which 'the animate light' (Hildegard von Bingen) was 'earthed' for the first time and brought down to the micro level. The work was an interactive, large image installation consisting of slide material 400 cm high and 160 cm wide.[24] A boar skull was chosen as a motif, a large-sized black-and-white photo work of the artist (*Skull* [*Schädel*], 1997), whose negative was starting to fall apart due to colonisation by bacteria. This act of colonisation of the alleged 'dead' by the alleged 'living' can be marked as the beginning of the 'bacterial art' of Sabine Kacunko. The process set in motion was documented with a digital imaging procedure by using slides to present the decay of the negative from its initial stage to the advanced destruction. (fig. 97.)

With this and numerous ensuing installations under the hypernym *P.O.L. Art* (*Product of Life*), Sabine Kacunko set out in uncharted artistic, medial and scientific waters. She became fully aware of the related risk at the moment of setting out. This group of works remained distinctive for the next decade, for example the installation *Culture Round Culture* (2002). Here the artist let bacteria eat an original negative with the image of a fish (*Fish* [*Fisch*], 1997). The process of the decomposing negative was projected live onto the wall with all the paradoxes showing up in this context. "*The observer becomes,*" Sabine Kacunko states in a description of the project, "*a witness of the different phases of decay and destruction. The fleeting has the potential for something completely new and different.*" This project questioned at a general level "*the present time in the context of culture and religion*" falling obviously on good ground. *Culture Round Culture* was the first realised collaboration between Sabine Kacunko and the geologist and microbiologist, Wolfgang Krumbein.[25] The fruitful dialogue between art and science in the artist's oeuvre has been deepened and intensified ever since; not least in the pursuit for the suitable mediation processes of this dialogue, which are increasingly shifting into the public sphere.

The required analysis of the meaning behind the origination process of large-sized photo objects by Sabine Kacunko stretches *pars pro toto* from her complete

Figure 98: Sabine Kacunko, *Bloody Moon*. Installation, Kunstpalast Düsseldorf 2003 © Sabine Kacunko

oeuvre to the highlighted origination process of her 'bacteria images'. The ensuing video installations, among others *Life* (*Leben*, 2002), can be seen as a consistent continuation of the photographic and videographic *natura morta e viva* of the artist (Kacunko 2004, p. 728), who has been evolving since the mid-1990s. The 'artistic' engages thus in a dialog with the 'natural', with the content and the meaning, the 'animate' of the art opposes the formally seemingly 'dead' motif from the nature and experiencing simultaneously its continuous living in it.

10.2.1 SAY(IL)ING / BO(O)TSCHAFT

The early and interim phase of Kacunko's work was followed by the project *SAY(IL)ING* [*BO(O)TSCHAFT*] that has been realised in several stages. This project focuses primarily on the objects in the public sphere with a particular cultural or ecological background. The starting point creates the increasing excessive demand of the bearer of democratic decision-making processes under globalised conditions of medial and any other hyperproduction. In this regard, according to

Figure 99: Sabine Kacunko, *BOOTSCHAFT-Plange Mühle*. Installation, Düsseldorf 2006 © Sabine Kacunko

the initial analysis of the artist, it is becoming more and more important to illuminate both metaphorically and factually the individual contents, among which are the surfaces of natural and cultural 'sayings', and thus to visualise their meaning and significance. By using existing and newly visualised techniques, the patina of an object (e.g. a public building) will be projected onto the surface of the same object as a live video image. Thanks to the medial visualisation of its microscopic structure, the 'history' and the 'present' of the illuminated object and its surroundings 'unwind'. It is circularly demonstrated, documented and presented to the public for reflection and discussion. It transforms the new medial and material presence of the represented object into a cultural subject. This constellation of observed and observing subjects evokes the tendencies of the present interaction with the 'objects' and 'subjects' of the natural-historical and cultural-historical 'things' and 'agencies'. These tendencies were first put forward by Bruno Latour and later widely adopted. (for critique of Latour's position cf. Ch. 1)

The 'contextually fixed' interaction with the visualisation techniques gains relevance and topicality through the interlocking of technology, culture, ecology and economy, which obviously does not orientate itself primarily to economic growth. The growth that Sabine Kacunko acts on encloses, however, the logic of the above separate disciplines in the age of (as to referred by Latour) 'techno cultures', by focusing on their mutual 'resource-materialistic' (cf. Kacunko 2010) fundaments and future prospects. The project *SAY(IL)ING* is, in this regard, based upon a seemingly simple 'observation': microbes produce the natural patina. Under the influence of the micro organisms, temperature, wind, air, water as well as chemical and organic substances solved in them, create a protective film, which adheres on the dusty surface of an object like a fingerprint. The natural biofilm – the 'patina' – protects objects from decay as analogous memory of the past. Art poses in this context as a 'guardian' of this sensible protective layer, which (re) presents simultaneously a medial-material 'natural-analogous' bearer of culture/nature. (fig. 99.)

10.2.2 Patina

The term 'patina'[26] shows especially clearly what political-shattering effect hides in the recognition of the beauty of irreversibility and what kind of aesthetic and perception-psychological aspects the acceptance of the patina involves. While some look at the elimination of traces of time as an "*intolerable 'facelifting'*" that "*negates the history of the objects*" (Toyka 1996, p. 7), some attribute it with 'dignity' and a protective function. So far, unfortunately, it has not gone beyond wishful statements that questions of patina should be asked, not least perception-psychologically but also "*based on what criteria the rejection or acceptance of patina is defined consciously or unconsciously. So where is the border between the pollution, decomposition, destruction on the one hand and the acceptable signs of use of age-related color shifts and any patina on the other?*" (12)

The *Naturalis Historiae* of Pliny the Elder handles the subject of the surface treatment of bronze statues or questions about the reflection of real bronze signs much more rationally than modern times; with J. J. Winckelmann on the one hand, and the Romantics on the other. Art and science have seldom been in the position to mediate consciously and effectively between the yearning for a lost life in accordance with nature on the one hand and the future utopia on the other hand. The rightly oft-quoted [*The*] *Lure of Antiquity and the Cult of the Machine* (Bredekamp 1993) were thrown out of the mutually dependent balance on the release of the influential study of the same name from 1993. The border between the patina – conceived as protection and seen as ruin – is also the interface where art and nature, matter and spirit as well as philosophy, religion and other views intertwine in a particularly pronounced way. (Art) history is both *read*able and *measur*able from the patina as from a biofilm. The relevance of the patina and its microbial condition for natural and cultural history does not only result from the relatively new ascertainment of geology that the bio-erosion (caused by the colonisation of bacteria and other microbes) has stronger impact on material than, for instance, wind erosion. We learn from it too that the balance is dependent on material and environmental influences in equal measure; the micro level and the macro level. If one wanted to express it in W. E. Krummbein's words – put bluntly – one could say: "*Nothing is dirt, everything is life.*"[27] From this consciously 'vitalism-suspecting pseudo animism' not only can the new research priorities and fields of the modern art be derived; but politically sensitive questions of the preservation of monuments, their publicity and sustainability are put into a new perspective as well. The fact is that nowadays the "*decision about monument worthiness*" is "*no longer in the hands of the public or public force*" but "*partly at the discretion of a segmented public or even an individual person*" (Ratzmann 2008, p. 41) – these facts also have to be seen as a consequence of privatisation strategies, the strengthened will for the power of images, their digital storage and complete attribution as well as manipulation.

10.2.3 Life

The question about 'life' under the conditions of its decay and simultaneous mechanic-chemical reproduction is posed in the context of the complete oeuvre of Sabine Kacunko both from the artistic and the scientific perspective. We know the aspects of the molecular machinery, the circuit of metabolism and the genetic network as well as the aspects of the biosynthesis of the membrane, but we still do not know what makes the living cell naturally alive. (Kauffman 2002, p. 126) A significant contribution about this 'life question' comes from the biochemist and physicist, astronomer and philosopher, doctor and system theorist, Stuart Kauffman. In his work with models in the various areas of biology, especially in developmental and evolutionary biology, he points out that the understanding of the fundaments of 'life' for biology would mean the establishment of a so-called 'general biology'. This general biology would have to act free from the restraints of a terrestrial biology, which is the only one that we have known so far, in order to be able to ask the questions about the laws of the biosphere in the entire universe. (cf. Kauffman 2004 & Atkins 2002) Thus the 'Gaia' hypothesis today is experiencing not only its actualisation accepted in expert circles, but also its expansion. For the argument here analyzed by Sabine Kacunko in her numerous media performances, it is important that the perspective expansion in Kauffman's theory happens only through a criticism of the reductionist scientific model. With her project *SAY(IL)ING* [*BO(O)TSCHAFT*] she not only distances herself from the rhetoric of the artificial life and artificial intelligence art and research, but she also applies the means and methods of molecular biology, geology and other natural scientific disciplines in order to continue the on-going disputes between the 'macro narratives' and 'micro narratives'. The key question of the book *What is life* (1944) by Erwin Schrödinger (Schrödinger 1951) referred to the source of the astonishing order in the 'biological system'. The answer to this question did not reply to the question, according to Kauffman, that was asked in Schrödinger's book title. To put it simply, he 'shortened' his question about 'life' that led him to the assumption that the order of the living requires a stability of chemical bonds. He presumed this stability – unlike his first correct presumption – in the aperiodic crystals, whose structure would have to include a microcode of the animate organism. About a decade later James D. Watson and Francis Crick discovered indeed the molecular structure of the aperiodic consistency of the desoxyribonucleic acid (DNA), whose microcode, in the sense of the genetic code itself, was understood another decade later. However, unlike the co-founder of the quantum theory and the 'philosophic physicist' Schrödinger, Kauffman did not pose the question on what the source of the biological order is, but: "*what must a physical system be in order to be an autonomous agent?*" Kauffman's 'tentative' answer was: "*An autonomous agent must be in the position to reproduce itself (1) and to accomplish at least one thermodynamic operating cycle (2).*" (Kauffman 2002, p.128f.) Kauffman takes a bacterium in a glucose solution as an example. The bacteria 'love' sugar, as many of us know, and by swimming in such an environment, they fulfil the operating cycle of life apart of their ability to reproduce themselves asexually through splitting. Subsequently, Kauffman not only admits that his 'tentative' definition of the 'autonomous agent' (≡ the 'animate') remains circular, but he also demonstrates that this particular 'provisional' character of the definition *in this case* shows the essence in this definiendum. At this point there is no need to quote the concrete chemical systems described by Kauffman; (130–1) the characteristics of his 'provisional' 'autonomous agent', which can be derived from the definition, are important. The system 'works' only *outside* the chemical balance, i.e. the 'autonomous agent' depends on an asymmetry, that is, an imbalance. As such the 'autonomous agent' creates a new class of 'networks with systemic unbalancing' with an innate self-reproduction and the operating cycles. The concept 'work' (occasionally used metaphorically as 'play', but, of course, in the 'case of life' it is irrelevant what term is used here as a metaphor for another one) remains meanwhile problematic, because it stays – first – open, from which the impulse for ‘work’ comes and – second – ‘work’ cannot be done in isolation. The universe must be divided into at least two parts (‘material’ and ‘environment’). This division in ‘material’ and ‘environment’ means thus: a limitation, a constraint, but also a rule or a law. But where do these come from, without having already done the ‘work’ of their becoming. This question shows that they – applied to ‘life’ – produce a vicious circle.

Schrödinger’s question about the ‘source of the biological order’ or ‘life’ could, according to Kauffman, do nothing better than generate an ‘information-technical’ or ‘informatic’ concept with the assumption of ‘stored information’ in the microcode of an aperiodic crystal. The specific arrangement of constraints responsible for the release of energy, this ‘stored information’ can be used to produce new energy that can be used for the new ‘work’, which again creates new constraints etc. Although a dividing bacterium does precisely this, we do not have even a draft for an adequate theory to explain the organisation of the process of energy release and its influence (the philosophers would call it ‘causality’).[28]

So the theoretical fundaments of the arranged marriage between information technology and molecular biology would have to be asked practically about their legitimacy. Therefore it is no surprise when Kauffman describes, in the same breath, the dispersion pattern of microscopic monads and their macroscopic counterparts of the biosphere – the endangered rain forests. From it and again using the example of the “*obscure molecular mutation in the bacterium*”, Kauffman derives his most famous thesis: that the self-organisation in the creation of the complexity of organisms and biological systems is as important a factor as the Darwinian selection.[29] The unpredictability reinforced with it – the deadly sin of computing – could be also conceived as a chance, as Kauffman writes in the conclusion: “*Life is inherently open, and its understanding will require raising physics and chemistry to new levels, wherein the future is open rather than predictable in prestated categories*.” (Kauffman 2002, p. 140).

10.2.4 Environment

In the decades since Ada Lovelace’s time many of the achievements of artists and scientists have been ignored and it would be meaningful and purposeful nowadays to re-evaluate the opportune constraints of the defiant positions to the globalised and networked, curricular, military and commercial science, military and economy. (cf. representatively Ryan 1992) Sabine Kacunko asks a number of questions with her project *SAY(IL)ING* [*BO(O)TSCHAFT*] referring directly to the principles of 'lab art' that obeys the 'techno sciences'. The public space turns into a lab, in which the interrelations of things or creatures with their environment is analyzed and continuously communicated. The precarious relationship between wind erosion and bio-erosion (bacteria and other microbes) is, for example, analyzed between the analogous and virtual public space. While sensual perception on the one hand and mechanical measure on the other hand, enter into a (self)-confident opening dialogue and the so-called aesthetic experience of the recipients remains oscillating at the interface between various concepts. In particular, the question about the condition of cultural goods in the context of a sustainable development is put forward.

Not only does the currently widely discussed system 'environment', often reduced to temperature affected changes, become an artistic subject. But also the system 'material', the microbial biofilm and the intercontinental migration of bacteria by means of desert dust come to the fore. Sabine Kacunko explains the issue of the desertification by using the example of the expansion of the Gobi Desert and China's efforts to stop this tendency with the project 'China's green wall'. For the interactive installation *SAY(IL)ING – HAN HAI* (*Dry Sea*), presented in Beijing in October 2009, microscopic image files of cultures of fungi from the Gobi Desert were produced. (fig. 100.) The microcosm of the cultures of fungi from the 'desert

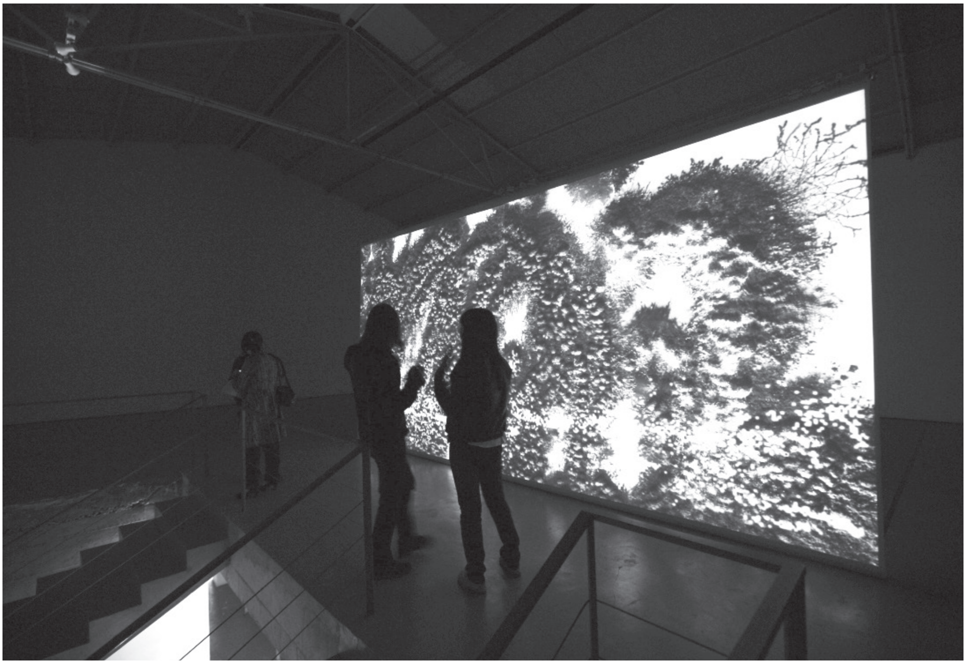

Figure 100: Sabine Kacunko, *Dry Sea*. Interactive Installation, Platform China Contemporary Art Institute Peking 2009. © Sabine Kacunko

Figure 101: Sabine Kacunko, *BOOTSCHAFT-Life Flag*. Installation and events in the public space, Berlin. Here: Ambassy of Israel, Berlin 2010. © Sabine Kacunko

patina' grown by Anna Gorbuschina (BAM Berlin) was projected onto a screen, but the more exhibition visitors that entered the room, the more the patina image faded away, the less the pristine ecological and aesthetic balance persisted.

A year later Sabine Kacunko managed to create another diplomatic piece of art, in which the appellative aspect stepped out of the shadows of the visualised processes even more. On the occasion of the 300th anniversary of the Charité Berlin, an exhibition and art action titled *LIFE FLAG – NEWS FROM EVERYWHERE* took place at the Robert-Koch-Forum / Institute for Microbiology and Hygiene as well as other places in Berlin in October and November 2010. (fig. 101.) The project was realised in collaboration with the Institute for Microbiology and Hygiene of the Charité Berlin and the Federal Institute for Materials Research and Testing. The complete action picked out the ecological, political and economic balance and both conscious and unconscious human activities involved in it as a central theme and reflected them within the frame of Berlin's scientific year 2010. The project consisted of a series of different media art actions and events in the public space. Its focus was on the efforts for a synthesis out of economic growth and environment protection as a challenge for the 21st century. The densely distributed network out of 129 embassies in Berlin – the European capital with the most diplomatic representative bodies – was used for the circulation of the *SAY(IL)ING*, which, printed out literally on flags, had a divided sensibility of ecological concerns together as a motif, metaphor, model, material and medium. The participating 75 embassies received the *LIFE FLAG*, a flag with the same motif, which was flown in all the embassy buildings for a week. The presentation of micro organisms was chosen as a fundament for the motif. Their 'protein factories', the so-called ribosomes, were coloured with molecular-biological technologies, the FISH (*fluorescence in situ hybridisation*) diagnostics**,** by a team at the Institute for Microbiology and Hygiene at the Charité. The thus visibly made ribosomes appear both in bacteria, plants and animals as well as in humans. In the process a new subunit of the 16s rRNA sequence was discovered that occurs in plants, animals and humans and the artist as its discoverer named this 'Oceanobacillus Pulvirenatus' – 'Dusty Rebirth'. The bacteria cultures originated from a historically unique dust sample from the Sahara Desert, which Alexander von Humboldt received as a gift in 1823. Today the sample is in the Naturkunde Museum Berlin and is property of the Ehrenberg collection. The Berlin action was also the starting point for further art actions that were continued over the globally spread network of embassies (and on the Internet too). (fig. 102.)

The question that arose here was and is: What particular meaning can such invisible processes to the unaided eye have for us? First, is certainly the meaning

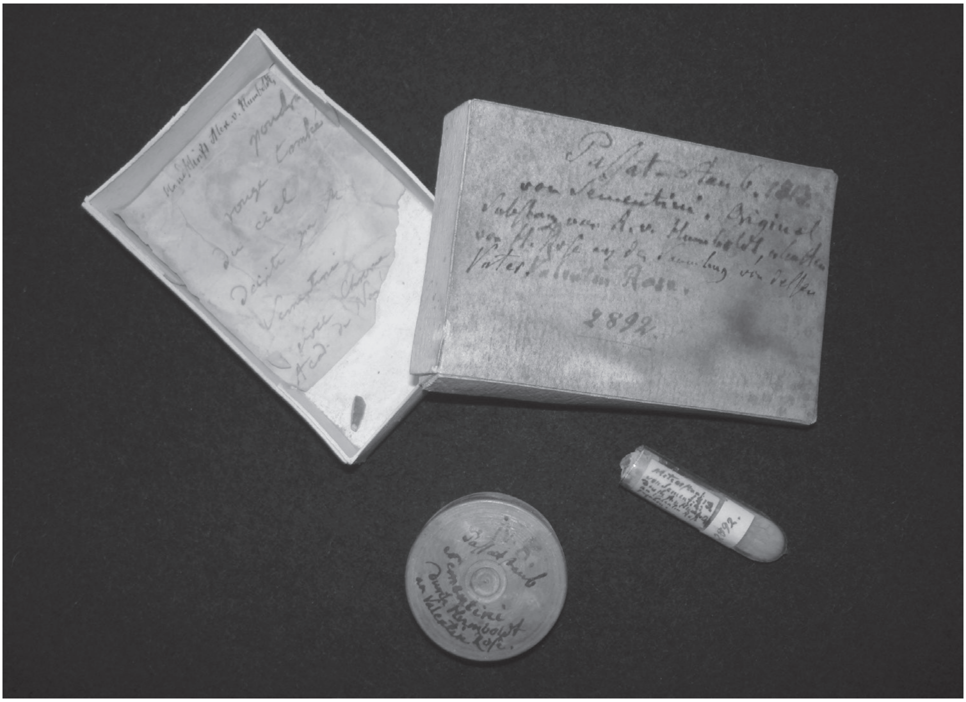

Figure 102: Sabine Kacunko, Alexander von Humboldt's dust sample from the Ehrenberg Collection, Berlin 2011. © Sabine Kacunko

of the operation matrix of our biotechnological age, in which molecular biology, above all genetics, in connection with computer technology as bioinformatics amalgamate into a new powerful technological reality. The possibility for isolation, identification and recombination of genes makes hence the gene pool of our planet accessible as a primary raw material resource. *LIFE FLAG* used the methods of recombination in the service of a *BO(O)TSCHAFT / SAY(IL)ING*, which addresses the application of ecological and human resources as well as art and science as sources of collective knowledge. In this way Sabine Kacunko celebrates with this project not an appellative or utopian art, but a deeply realistic one, since it is based on existing networks. Not only the virtual networks of the Internet but the naturally and culturally analogous networks of embassies and messages, the representatives of the humankind.

Second, the question about the meaning of invisible processes, which *LIFE FLAG* supported, was not least visibly answered. The extremely efficient, pigment-forming micro organisms that were visualised on the surface of the *LIFE FLAG* make sure that one can speak rightly so of the smallest biological causes with great aesthetic impact. A social plastic (maybe not entirely in the sense of J.

Beuys) without the stagnancy of a sculptural form, but an animate transformation – a message, so to say, made sure that the artistic process was grasped as an emergence of culture as an expression of the transformation of nature. *LIFE FLAG* served as a symbol and metaphor for this transformation of the animate, which represents its constitutive condition. (fig. 102.)

10.2.5 Bacteria

Since the successful reanimation of the historical dust sample in *LIFE FLAG*, the artist has made further visible traces in the dust the subject of her investigation. The 'reanimated' bacteria cultures created digital and analogous sayings; they became the centrepiece and initial point of the ensuing media installation and other projects. In these projects, the blunt beauty of the bacteria culture in its other, all-embracing meanings was brought to the public's attention.

Sabine Kacunko repeatedly points out in her projects the multiple 'functions' or views that the bacteria convey to us. They function first as living solar cells. The earliest known so-called archaea or archaebacteria were the blue-green coloured cyanobacteria, which built the material as marine blue-green algae and make up the stromatolites (nodular calcifications) in Australia. (Lesch & Zaun 2009, p. 17.)[30] The blue-green pigmented cyanobacteria, thanks to the chlorophyll they contain, are regarded as 'inventors' of photosynthesis, that (including the carbon dioxide by means of light-absorbing pigments) is responsible for the transformation of sunlight into chemical energy. They thus created their own metabolism and ability to reproduce (asexually, by division) making the bacteria unlike the equally old, resistant and metamorphic (but still captured between 'life' and 'death') viruses into the 'animate' creatures in the most accepted sense of this word.

The second 'field of application' of the bacteria here described in an artistic, scientific and epistemological context, is associated with the 'second nature' of bacteria: pigment formation. The bacteria act as living pigments and are hence responsible for the perceivable diversity of our world. The micro organisms produce in their metabolic processes pigments as waste products and thus a new artistic-aesthetic experience. Apart of the soft-focus impact of the affected surface the specific aesthetic appeal of the thus emerging 'natural' – and in the case of the 'bacteria art' by Sabine Kacunko also 'artistic' – patina, lies, above all, in its colour. The subjective 'nature of colour' receives, however, through the artistic intervention its objective, resource-technical 'grounding', by putting the bearer, the molecular processes responsible for the pigmentation, at the centre of attention. The colour of the respective object contains its subjective constitution traditionally, first through the implementation of idealistic chromatics. And second, the colour of the object is physically seen and determined by the wavelengths and intensities of the light emerging out of it – through its ability to reflect. This view, too, contains subjective elements through the change of the observer's position. Philosophers like Ludwig Wittgenstein or Ernst Cassirer demanded at the beginning of the 20th century to correlate the physical, philosophical and also art-theoretical reflection to 'colour'. Rightly so it was suggested that a polemic of the natural philosophy against the physical observation of the light would be amiss.[31]

Particularly interesting with regard to the bacteria art of Sabine Kacunko, is the 'ambivalent' function of melanin, whose impact still doesn't seem to be understood despite intensive experimental researches. Melanin as black pigment is responsible for colour changes on the surface. In other words, they are responsible for the 'patinisation' of mineral substrates[32], but their impact has a protective as well as a destructive force. Comprehension of the relation between the ecology of the micro organisms on surfaces and the radiation to which they are exposed – of the 'material' and its 'environment' – could possibly be reached also through a genetically controlled intervention into the production of photoactive melanin. The 'ambivalence' of melanin as a ('protective', unreactive) stable radical lies also in its light sensitivity, because under the influence of light, sulphurous pheomelanins they can create free ('destructive', reactive) radicals.

In Sabine Kacunko's work notes there are, amongst other items, references coming from the Max Planck Institute for developmental biology[33] taken on 4th September 2003 about the evolution of social swarming in bacteria, a subject that adds another quality to the abilities of these micro organisms than those already discussed. The references relate to the 'social' difference between the wild types of the soil bacterium, *Myxococcus xanthus*, and its mutants. While the former swarm together on soft fertile soil (*Agar*), their non-social mutants lose certain extra-cellular extensions (*Pili*).[34]

Generating artistic value out of such molecular-biological proof of the social behaviour of bacteria could not succeed without further ado after everything that has been said *if* the verifiable development of a matching artistic concept is missing. To Sabine Kacunko it was, however, important to refrain from easily digestible parallels at this undoubtedly tempting point. This parallel between people, social animals and many kinds of bacteria on the one hand and the survival behaviour of our entire eco-system with the people at the top on the other, reaches deeply into the insights and assumptions about 'life' previously discussed. It is especially interesting that the 'ambivalence' of bacteria mentioned above is shown in the context of patina formation, which relates to the destruction and the protection of the respective substance. Its 'social behaviour' and 'cooperation' goes so far in the Myxobacteria (to which the *Myxococcus xanthus* belong) that they gather in large groups in order to swarm over surfaces and chase and kill 'victim organisms'. If they find conditions particularly austere, they unite in groups of up to 100,000 *Myxococcus xanthus* cells, which then create a three-dimensional semen structure in order to survive the lack of food, drying out or heat.

The bacteria clearly do not even fear 'self sacrifice' in the service of the whole, which certainly should not be seen as a contradiction to the formation of their 'individuality'. The mass expansion or swarms of bacteria is presumed to be the first step in the creation of biofilms, including 'organic dust'. In this process we see the development of something similar to the short-term and long-term memory of the bacteria. A daughter cell 'learns' and 'decides' faster than the parent cell.[35]

10.2.6 Crystals

One year after the big project in Berlin, the media art project *SAY(IL)ING – CRYSTAL MIRROR* was presented at the Ecolé des Beaux-Arts in Paris on 27th November 2011.[36] In an accessible media sculpture made out of carbon there was a video microscope, beneath which was a Petri dish, which contained animate cell cultures that could be experienced in an audio-visual manner. The cells in question were the historical bacteria culture from the Ehrenberg, which had also been the starting point in *SAY(IL)ING – LIFE FLAG* and were reactivated or 'reanimated' by Prof. Dr. Anna Gorbuschina. Images of the growth process of the reanimated bacteria cultures were transmitted live on the Internet and were thus accessible on the project's website for virtual visitors. The carbon sculpture referred to the coordinates of the Pyramid of Cheops and consisted of the reflection of the pyramid apex in an octahedron, to which ultra sound spots were attached. By using a specially developed software, the bases of the bacteria cultures' DNA were transformed into tones and by using the current wind coordinates on site they were output as sounds and thus passed onto the external world. (fig. 103.)

The desert dust was originally found in Calabria and handed to the humanist Alexander von Humboldt in Paris in 1823, who then submitted it for evaluation in Berlin. It was determined that the dust originated from the Sahara and had been carried over the trade winds to Italy. This was the first scientific proof of the

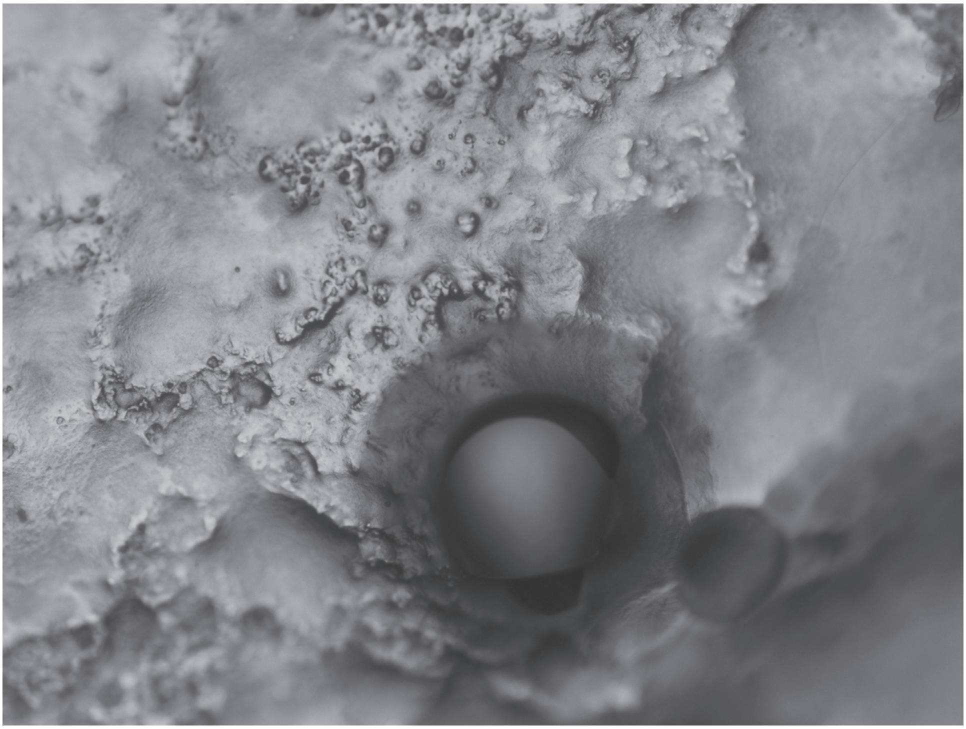

Figure 103: Sabine Kacunko, Micrograph of the reactivated microorganisms from Humboldt's dust sample from the Ehrenberg Collection, Berlin 2011. © Sabine Kacunko

correlation of various eco-systems. The micro organisms from the Sahara Desert today feed further eco-systems on their way to Europe, as well as the rainforests in South America. The Sahara dust reaches Paris via a strong south current over the Mediterranean and the Alps. The winds bring plant nutritive substances such as calcium, magnesium or micro organisms with the North African dust. Dust, sand and organic material have permanently been transported from the barren dry desert of the Sahara to the tropical rainforests of South America by the wind.

The 'rebirth' of an almost 200-year-old bacterium as a product of interdisciplinary collaboration and the productive interplay of culture, politics and science is seldom so strongly associated with a historical personality like Alexander von Humboldt. The German humanist lived and worked in Paris for many years up until 1827. As is well known, there were many practical aspects to Humboldt's research work. The human was supposed to be enabled to use nature as sustainably as possible.[37] This narrative was conceptualized and reflected in the structure of *CRYSTAL MIRROR*. (fig. 104.)

Figure 104: Sabine Kacunko, *BOOTSCHAFT- Crystal Mirror*. Media sculpture, École nationale supérieure des Beaux-Arts de Paris (ENSBA) 2011. © Sabine Kacunko

10.2.7 Asymmetry

At this point another fascinating aspect of the social life of bacteria arose, both in artistic awareness and as an experiment in praxis. This aspect adds to the three mentioned characteristics of bacteria, thus temporarily closing the circle around 'life', 'death' and the 'dusty rebirth' in the artistic work of Sabine Kacunko. But here it is necessary to turn once again to a contemporary of Robert Koch. Around 1860, Louis Pasteur noticed that polarised light rotates by 7 degrees in natural tartaric acid, but not in synthetically produced tartaric acid. Natural tartaric acid, which contains only one kind of crystal, is optically active and therefore rotates the polarisation level of the polarisation light. The synthetically produced tartaric acid, on the other hand, contains two kinds of crystal, one of which is merely the mirror image of the other. The mineralogist Pierre Curie continued to develop thoughts on the difference between 'animate' and 'inanimate', before it was finally presented in 1926 by his Ukrainian-Russian colleague, Wladimir Iwanowitsch Wernadski, as the "Pasteur Curie principle of dissymmetry". From this demarcation line between animate and inanimate systems in relation to symmetry differences between crystals and creatures, Wernadski derived that one can distinguish a biological from a physical space-time continuum. (Krumbein & Levit 1997).[38]

Following Pasteur, Curie and Wernadski's biogenic dissymmetry,[39] natural minerals (in accordance with the 32 crystal classes of the Euclidean order) are inanimate, whereas natural organisms (entities comprised of molecules similar to minerals) are animate. Whilst constantly symmetric minerals can form, at maximum, an hexakis octahedron or can comprise 48 hedrons in their most advanced form (such as a garnet or a carbuncle stone), organisms have greater numbers of levels of symmetry, with more complex forms than an hexakis octahedron, albeit without being precisely symmetrical (left and right brain hemisphere, left and right hand, both single strands of a DNA double helix, and so on). That is why the creation of dissymmetry in biological membranes can be regarded as what has long been believed to be the difference of the 'animate' (dissymmetrical examples from biology include amino acids rotating to the left and right, carboxylic acids, and sugar). The dissymmetric or animate state is maintained, according to geologist, W. E. Krummbein, "*through the animate matter using cosmic means (solar energy and stardust) against the thermodynamic laws. It marks explicitly the topology (phenomena) and mode of operation (processes) of the neuronal cells and systems (networks), but not those of the computers that are symmetric and work symmetrically*." (Krumbein and Levit 1997, p. 35)[40] It follows from this theory, for example, that human life and its end might not be connected with brain function. Bacteria and other collections of atoms were proof of this (they 'live' without brain function) and digital computers were used as negative examples. A thesis which set invisible, yet fundamental, irreversible boundaries to the range of biosciences. Herein lies a real chance to use productively and synergetically (certainly not in the sense of their economic usability) the connections between art, science, philosophy, religion and other views, as well as life praxis.

"*Life is the dynamic process of the symmetry breaking using energy in the dyssymmetric system between membrane enclosed cell incident dependent on the entropy and the forceful temporal feedback with simultaneous like earlier (fossil) dyssymmetries, fossil biospheres, out of which the current earth extracts energy and material sources*." (ibid.)[41]

Viewing 'life' as a fundamental activity of the biosphere, conceived as a highly organised system of matter and energy, leads to a long overdue notion of the dynamic balance of the eco-system of Earth and, under favourable conditions, to the possible prevention of our premature death in a bacterially-dominated system. Bacteria yield an almost infinite diversity of colours, structures and interac-

Figure 105: Sabine Kacunko, *BOOTSCHAFT- Crystal Mirror*. Media sculpture, École nationale supérieure des Beaux-Arts de Paris (ENSBA) 2011. © Sabine Kacunko

tions with the environment. The bacteria art of Sabine Kacunko shows us clearly the mapped asymptotic convergence of instrumental questions and questions of meaning. (fig. 105.)

10.2.8 Conclusion

One of the founders and probably the most influential personality in international biosemiotics, the Dane Jesper Hoffmeyer, arrived at a very similar outcome in the description of asymmetric cell membranes as output sources of 'unpredictability' and 'life':

"*From a semiotic point of view the decisive step in the process that led to the origin of life was the appearance in the world of a new kind of asymmetry, 'an asymmetry between insides and outside.'* (Hoffmeyer 2010) *The formation of a closed membrane around an autocatalytically closed system of components … 'Such a stable integration of a self-referential digitally coded system into an other-referential analogically coded system may perhaps be seen as a definition of life.'*"[42]

From this mediative and easily balanced position between analogy and digital biologism, a position that wants to avoid a 'semantic cut' (and which Hoffmeyer was able to maintain through a double, analogous-digital coding[43]), the relevance of the complete artistic-scientific project of Sabine Kacunko can be appreciated, which has acquired relevance beyond the versatility and multiplicity of the visu-

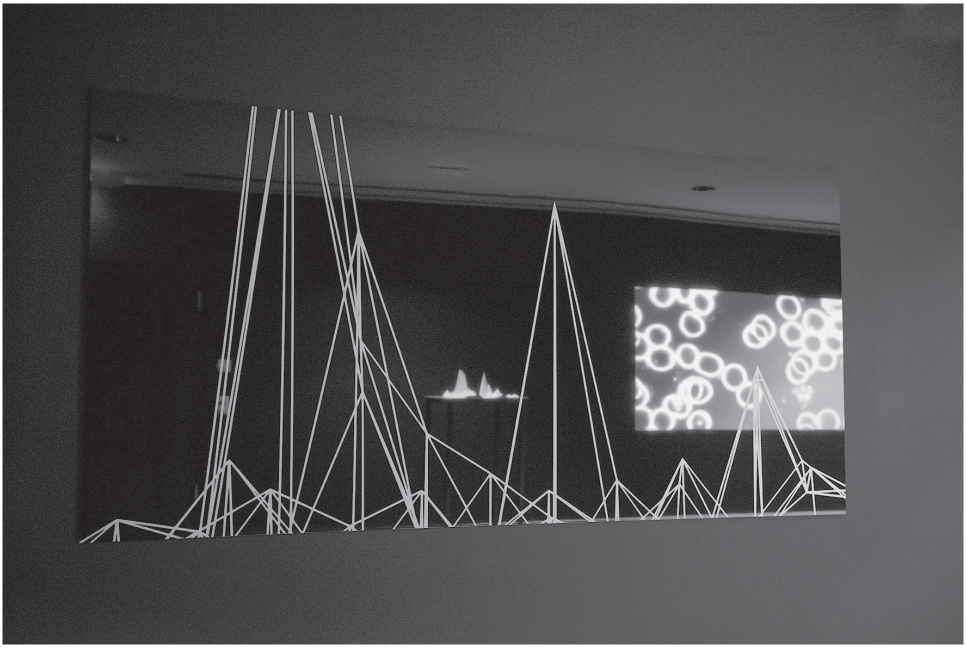

Figure 106: Sabine Kacunko, Looping Life. Media performance. Collegium Hungaricum Berlin (CHB), exhibition view 2013 © Sabine Kacunko

alisation technologies used and crosses the narrow circle of art and its history, the art market as well as natural and cultural politics. The principle of recording, processing and reproducing the invisible in the context of the visualisation methods and strategies in art of the 20th and 21st centuries can be understood by looking at the *SAY(IL)ING* project beyond the artistic-aesthetic dimension as an epistemic model, as a social metaphor and also as a test case of interactivity. However, this project demanded an artistic-scientific method of continued persistence, which spared no efforts in assessing a triple parallel between the development of the media engineering, modern and contemporary art and culture and the corresponding theory formations. The project *SAY(IL)ING* by Sabine Kacunko heads in this direction exactly, like the recent work entitled *Looping Life* (2013). (fig. 106.)

Connecting the open-for-interpretation surface of images with the development of art and media history, gives the most insightful approach to access Sabine Kacunko's work. The impossibility of penetrating the shown work beyond the surface of the artist's images inevitably poses the question about the meaning and expressiveness of the (re)presented formation and decay processes of the photographic, videographic and digital image. From the chaos and the method, with which she artistically perpetrates death and its healing, Sabine Kacunko has unlocked an interdisciplinary field of research, in the best sense of the word, whose outcomes contribute to the pivotal questions: what the meaning of art in an engineered society is and to what extent does it still have the capacity to visualise, interpret and represent the world in the media age.

82 Original text: "*Mais il est écrit en danois, et seules les citations, les références et les illustrations m'en laissent deviner le contenu et l'intérêt. Il eut été souhaitable qu'au moment où paraissait cet opuscule d'une cinquantaine de pages, on en fit une traduction. Il serait encore plus souhaitable que Dyggve acceptât, après quinze années écoulées, de le refondre et d'y consigner le dernier état de sa pensée. / Ces quelques lignes traduisent assurément de façon bien incomplete dans leur brièveté, et bien trop schématique, la richesse, la diversité, l' ingéniosité créatrice d' un esprit qui a encore beaucoup à nous apporter. Que Ejnar Dyggve me permette pourtant de les lui offrir, au nom de tous, en témoignage d'affectueuse amitié*."

Chapter 10

1 The first two sections of this article summarise an attempt to build a network for interdisciplinary bacterial research at its early stage. Although the ideas and formulations do not yet include the later, further elaborated aspects like subprojects and important mediation elements set up by the initial project group (ITP), I owe important inputs from the critical discussions with its members to whom I would like to give credits: Sabine Kacunko, Jens Hauser, Tobias Cheung, Thomas Söderqvist, Adam Bencard, Jens Lohfert Jørgensen, Thomas Bjarnsholt and Lone Gram as well as to other unnamed colleagues and institutions working between the humanities, science and arts who provide powerful impulses to this ambitious enterprise.

2 Kuhn 1962, Foucault 1966, Bloor 1976, Fleck et. al. 1979, Knorr-Cetina 1981 & 1995, Lynch 1985, Rheinberger 1997, Lenoir 1998, Burke 2000, Landwehr 2002, Zittel 2002, Sarasin 2003 & 2007.

3 With respect to both the historicising and the experimental approaches to 'life' on its most basic level – one cellular life of bacteria – competing requirements of life for a microbe exist and as such serve directly to the needs of synthetic biology or other applications of molecular biology. If membrane, responsiveness to the environment, metabolism, homeostasis (maintenance), reproduction, evolving (by accumulation of DNA mutations) (Wassenaar 2012, p. 37) fulfil these requirements, how do they fit into the much shorter requirement lists where only nutrition, growth and reproduction by fission or budding (Leduc 1911, p. 149) seem to serve well to build today's 'bio bricks'? Such questions still play an important role throughout the related meta-discussion.

4 Armstrong & Beesley 2011, De Lorenzo & Danchin 2008, Hauser 2008, Hauser & Schmidt 2011, Langton 1989, Leduc 1912, Newman 2004, Bedau 2007, Rasmussen et. al. 2009, Riskin 2007, DeLanda 2011, Thacker 2004, Spitzer 1942, Hoffmeyer 1998 & 2008.

5 Malina 2011, Jacques 2012, Edwards 2008 & 2010, Buczynski 2012, Klein 2010, Nowotny 2011, Naghshineh 2008, Repko 2008, Sethi 2009, Reilly et.al. 2005, Moran 2010, Reid 2011, Wilson 2001 & 2010.

6 The productivity of the methodological diversity between the (natural) sciences and (cultural) humanities are here accompanied by the less emotional, but still towards interdisciplinary-oriented analysis of the 'two cultures' (Snow, C. P. 1963 [1959]). The latter interdisciplinary approach is known from some of the leading academic projects like *Image Knowledge Gestaltung. An Interdisciplinary Laboratory* (Berlin) which partially inspired the structure of the presented project. Within the context of problem-oriented base projects, this project with inclusion of 22 disciplines aims to "*engage in inquiries that transcend the boundaries of each core discipline, while retaining a focus on their central research topics*." (HU, Berlin) [https://www.interdisciplinary-laboratory.hu-berlin.de/en].

7 Microbial dust as material and medium represents the first case of bacteria's agency to be systematised. Only recently, has dust's ubiquity and its permanent appearance "*as an element of mixing*

and circulation" (Gethmann & Wagner 2013) been approached from an interdisciplinary perspective, showing its future research potentials and important information both about the state of the current environment and about our behaviour and habits. In this context, bacteria's intercontinental migration in the form of biofilm dust from the Sahara to the Amazon and its importance, as well as the historical roots of this knowledge and awareness, have been initially described and publicly presented. Another concrete urgent issue related to the possible biofilm-based solution for the Gobi (and Beijing) has been emphasised by art and science projects in situ (Kacunko 2011, Kacunko & Gorbushina 2013c).

8 Research in the field of Biodeterioration (breakdown of materials by microbial action) and its control in the context of applying biotechnologies in cultural heritage protection and conservation relies on detailed knowledge of biogenic patina (*biopatina sensu lato*), that has lead to improvements in restoration treatments through the production of photo-active Melanine, needed for the replacement of monument components or for re-building purposes. The dialectics or 'ambivalence' of melanins is therefore highly important. Through their light-sensitivity they are performing their role as 'protective', inert or 'stable' radicals and at the same time, the sulphur-containing pheomelanines perform, through the influence of light, their 'destructive', reactive role as so-called 'free'-radicals. Cf. Caneva, Krummbein, Gorbushina, Kacunko and Wassenaar 2012: p. 179 (*pseudomonas*).

9 Bacteria's structural simplicity and the methods of the former's visualisation provided a certain systematic insight up to now, although mostly focused on the history of the molecular biology's experimentation. Further need for the explanation of the structural strength of the cell and its shape performed by peptidoglycan and MreB protein shall be provided by a systematisation of the visualisation practices of the bacteria and their underlying infinitesimal aesthetics. By looking into or sensing the cell itself, we know that "*addition (or removal) of a phosphate to a particular site of a protein (often an enzyme) will change its charge and sometimes its shape and, as a result of that, its function*." (Wasenaar 2012, p. 151) – Cf. Todar, Rheinberger 1997. – Molecular approach methods are: (1) the analysis of the amino acid sequences of key proteins; (2) the analysis of nucleic acid base sequences by establishing the percent of guanine (G) and cytosine (C); (3) nucleic acid hybridisation, which is essentially the mixing of single-stranded DNA from two species and determining the amount of base-pairing (closely related species will have more bases pairing); (4) nucleic acid sequencing especially looking at ribosomal RNA.

10 Cf. Chun & Rainey 2014. Some attempts to estimate the total number of bacterial and archaeal species on Earth suggest that this figure might be over a million.

11 Recent popular and introductory works as well as websites designed for educational purposes (Todar, Wassenaar 2012) recall the modernist popular metaphors related to the bacteriology of the last third of the 19th Century (cf. Sarasin et. al. 2007).

12 Cf. recent announcements about new synthetic biology circuits that combine memory and logic (Trafton 2013) and NRP-UEA-Norwich Project Overview online.

13 Between analysis and synthesis of the bacteria understood as agents, the research field of the system models and behavioural patterns provides the best appropriate environment for an interdisciplinary interpretation of the interactions between the bacterial, nonsexual cell division (by binary fission) and the mutual sensing and collective acting in sense of *Quorum Sensing* (cf. Bonnie Bassler bibliography).

14 Cf. Cheung 2010a & b, 2011, 2013, 2014. – For immunology and research of TTSS (Type Three Secretion System [appendices on a bacterial body that are used as an injection needle, to inject effector proteins into a eukaryotic target cell]) and bacterial toxin tagets cf. Wassenaar 2012: pp. 30–34 and 65–66.

15 Historicising of the discursive fields of Life as *res vivens* and the problem of agency has offered profound cultural-historical and anthropological insights into these philosophical, epistemic and medicinal questions, which are to be further elaborated with respect to bacteria and microbial research between the early Enlightenment and the modernity. Cf. Cheung 2008, 2011, 2013, 2014.

16 'Humoral' derives from the word 'humor', which, in this context, means 'fluid'. The human body was thought to contain a mix of the four humors: black bile (also known as melancholy), yellow or red bile, blood, and phlegm. Each individual had a particular humoral makeup, or 'constitution', and health was defined as the proper humoral balance for that individual. An imbalance of the humors resulted in disease.

17 These interests were accompanied by an avalanche of new scientific studies on the genetic basis of human behaviour (which brought Bateson's ecological aesthetics [Bateson 1973] and aesthetics of recursion back into play), the questions related to the concepts of culture (Guddemi), representation and information as well as to the links between complexity and cognition, consciousness and information appeared in both live and life-performing art as best-suited models and micro-systems for an experimental approach to both vision and cognition. Mentioning anthropology (Rappaport), molecular biology (Bruni) and the semiotics (Pierce), the issues linked to the observer within the real and mediated environments have opened further enquiry into what Otto Rössler described in his *Endophysics* as an attempt to approach the observer-question from the perspective of modern and quantum physics.

18 Poissant 2005 & 2012, Pandilovski 2008, Reichle 2005 & 2009, Edwards 2008 & 2010, Bunt 2008, Bulatov 2004, Anker & Nelkin 2004, Thacker 2003 & 2004 & 2005, Bolter 1999, Krohs & Toepfer 2005, Ray 1998, Bartens 1999, Fox Keller, Neumann-Held & Rehmann-Sutter 2006, Squier, Karafyllis 2003, Keck & Pethes 2001, Kelty, Rieger, Holzhey 2007, Gumbrecht, Pentecost 2008, Munster 2005, Hoppe-Sailer 2002, Gessert.

19 Cf. Malina 2009 & 2010 & 2012. – The question of whether the tools, information, resources and standpoints from other disciplines can answer the problems they are studying, has usually been left open. The typical focus of the more positively engaged voices covers the field from the typology of art-science collaboration. The typical complaint of the more critical tongues, especially from the sciences, tend to discuss the "*problem of the competing plethora of terms and initiatives for cross-disciplinary interactions, be they interdisciplinary, multidisciplinary, paradisciplinary, transdisciplinary and most recently antidisciplinary.*" (Zilberg 2012: p. 4). In his meta-analysis of a larger number of SEAD white papers related to the abovementioned themes, Jonathan Zilberg criticises the rhetoric of 'overcoming' the gap (or also *Breaking Down the Silo* [Malina]) between the "*two cultures*" both from the systematic and historical reasons ("*It is by and large taken uncritically as a self-evident truth which the authors universally seek to overcome*" [Zilberg 2012: p. 4]).

20 The artist (Berlin) is married to the author (Copenhagen). At this point neither the pre-history nor the process of their either converging or intersecting interests in bacteria research could be illustrated in detail. Any questions on the independence of their respective work and research and transparency, as well as on their possibly challenged scientific or artistic distance, can be answered by visiting their individual websites (www.slavkokacunko.com; www.sabinekacunko.de) as well as by using other independent offline and online sources (e.g. institutions they both have worked with, reviews, critiques etc.).

21 The term will be used without quotation marks in the remaining text.

22 Cf. *Pflanzenschutz und Umwelt*. Ed. From the Industrial association for herbicides and pesticides (incorporated society) (IPS), Frankfurt/M. – Cf. F. Klingauf, International Symposium for plant protection on 5th May 1981 in Gent, Belgium. Bulletin Deut. Pflanzenschutzd., Braunschweig 33, p. 159.

23 Size: 400 cm x 600 cm. Material: 20 Kb slides / 1 light box 20 cm x 200 cm / 1 Negativ 9 x 12 cm with bacteria cultures / 1 live camera / 1 computer / 1 projector / 1 metal shelf.

24 As in the installation *Origin of Light* (2001) the neon tubes attached to a motion sensor were fixated on the wall and activated through the motion of the exhibition visitors. But unlike there, the motif could be recognised in *Product of Life* when the light was turned off. Otherwise one could see within a deep black and strongly reflecting surface, the observer itself.

25 University Oldenburg, Department for Microbiology.

26 The term will be used without quotation marks in the remaining text.

27 Wolfgang Krummbein, verbal statement in an interview with author, Berlin 2009.

28 "*This organisation of process is carried out by any dividing cell, yet it is stunning that we have no language – at least, no mathematical language of which I am aware – able to describe the closure of process that propagates as a cell makes two, makes four, makes a colony and, ultimately, a biosphere. This self-propagating organisation of process is contained in the concept of a autonomous agent* […] *The cell exhibits a form of organisation that is not captured by our concept of information – a concept that leaves out any mention of constructing constraints on the actual occurrence of anything in the real physical world.*" Kauffman 2002, p. 135.

29 "*Could you say that an obscure molecular mutation in a bacterium might allow the bacterium to detect a calcium current from a ciliate and take evasive action? I think not. More generally, I think we just don't have the concepts ahead of time to state what all possible Darwinian preadaptations might be, nor can we state what all possible environments might be.*" Kauffman 2002, p. 137.

30 Meanwhile also old, possibly the oldest, cyanobacteria have been confirmed in New Mexico. However, this fact plays no significant role in this argument.

31 Cf. publications by Ulrich Ruschig and the Research Center for Critical Natural Philosophy (University Oldenburg). – Cf. Werner Heisenberg, 'Die Goethesche und die Newtonsche Ferbenlehre im Lichte der modernen Physik' (1941). in Heisenberg, W 1984, *Gesammelte Werke* (ed. by W Blum, H-P Dürr & H Rechenberg, section C. Volume 1.). Munich, pp.146–60. – Cf. J. Pawlik, *Theorie der Farbe*, Cologne 1969.

32 The charge transfer is presumed to be a possible cause for the change in colour of the surface. – Cf. Krummbein 2003 – Cf. Gorbushina, A A & Dornieden, T & Krumbein, W E 2000, Eppard, M, W E Krumbein, C Koch, E Rhiel, J T Staley & E Stackbrandt 1996.

33 Gregory J. Velicer and Yuen-tsu N. Yu from the Max-Planck Institute for developmental biology in Tübingen. Cf. *Nature*, vol. 425, 4, Sept. 2003. Further information online at [www.tuebingen.mpg.de].

34 Although two stems, which spring from the *Pili*-less mutants, have re-developed the ability of social swarming, they managed it with fundamentally different mechanisms and patterns than the wild type.

35 The following lines describe vividly this sort of social Darwinism: "*When the times get tough, the bacillus gets pregnant. The bacilli usually split evenly and homogeneously. As soon as tough times come, one of the two daughter cells or the mother cell transforms into a non-survivable protective cover. In this manner one of the two cells can outlive for centuries to reach new green habitats. The other will never again come alive. Affectionate self-sacrifice death and altruism are seen in the evolution theory too as the better survival principle, as 'kill in order not to be killed'.*" Krumbein, 1997.

36 The performance opened the 17th ICOMOS general assembly, which was under the auspices of the French President, Nicolas Sarkozy, and Irina Bokova, the Director-General of UNESCO.

37 The project *CRYSTAL MIRROR* in Paris made it also possible to trace back this story with a virtual parcours through Paris and to communicate complex relations between the environment and humankind with apps designed by Sabine Kacunko. By using additional GPS software the hotspots of the parcours (Louvre, Planetarium, Obelisk, Museum of Natural Science) became real experiencable places.

38 Cf. Krumbein 1997, pp.4–7.

39 Around 1860 Louis Pasteur noticed that the polarized light rotates by 7 degrees in natural tartaric acid unlike the synthetically produced tartaric acid. As a result of it only the natural tartaric acid, that contains only one kind of crystals, is optically active and therefore rotates the polarization level of the polarization light. The synthetically produced tartaric acid, on the other hand, contains two kinds of crystals, from which one kind of crystal is merely the mirror image of the other one. The mineralogist Pierre Curie continued developing the hence underlined difference between 'animate' and 'inanimate', before it was finally introduced in 1926 by his Ukrainian-Russian colleague Wladimir Iwanowitsch Wernadski (1863–1945) as the "Pasteur Curie principle of dissymmetry". Wernadski derives from this demarcation line between animate and inanimate systems regarding symmetry differences between crystals and creatures that one can distinguish a biological from a physical space-time continuum (cf. Krumbein and Levit 1997).

40 Further thoughts and observations from the field of dynamic morphology can be found in the D'Arcy W. Thompson's classic inquiry, in which the "very complicated phenomenon" of the asymmetry of the cell and the emergence of the chemical asymmetry according to the difference in the inner and outer pressure on the nucleus of the cell has been described. Cf. Thompson 1917, pp. 166; 168ff.

41 The quote is available online at [http://www.presse.uni-oldenburg.de/f-aktuell/9714ebkr.htm]. [accessed on 18 October 2014].

42 Under this premise a central meaning is ascribed to the topological alignment of biochemical processes for the understanding of 'life' in the sense of the cellular activity. "*Cellular membranes never form de novo by self-assembly of their constituents; they always grow, in an essentially homomorphic fashion, by accretion, that is, by the insertion of additional constituents into pre-existing membranes* […] *All major activities of cells are topologically connected to membranes. In the prokaryotes (bacteria) the plasma membrane (the active membrane inside the cell wall) is itself in charge of molecular and ionic transport, biosynthetic translocations (of proteins, glycosides etc.), assembly of lipids, communication (via receptors), electron transport and coupled phosphorylation, photoreduction photophosphorylation, and anchoring of the chromosome (replication) (de Duve 1991). In eukaryotic cells these tasks has been taken over by specific subcellular membrane structures of mitochondria, chloroplasts, the nuclear envelope, the Golgi apparatus, ribosomes, lysozomes etc.*" Hoffmeyer 2006, p. 15.

43 "*It is however important to stress the interdependence of the analog and the digital as two equally necessary forms of referential activity arising like twins in the individuation of that logic which we call life. The digital code is the seat for self-referential activity, i.e. the redescription in a sequential alphabet of all the macromolecular constituents of the organism, whereas the analog codes are engaged in non-self-referential activity, i.e. the semiotic looping of organism and environment into each other through the activity of their interface, the closed membrane. To claim that only the digital twin is semiotic whereas the analog twin remains in the sphere of classical dynamics is to block the only possibility for transcending Pattee's semantic cut position.*" Hoffmeyer 2006, p. 17.