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# The Art of DNA

*Das Verhältnis von Kunst und Wissenschaft war immer vielschichtig und ist heute im Zeitalter der Biotechnologie überaus prekär geworden, wie durch den Einsatz der ethisch umstrittenen Gentechnik in der zeitgenössischen Kunst deutlich wird. Schon vor Jahren haben Künstler das Atelier verlassen, um in den Laboratorien der modernen Life Sciences zu forschen und dort ihre Projekte entstehen zu lassen. Insbesondere Künstler der Transgenic Art, wie z. B. der Brasilianer Eduardo Kac (Art Institute Chicago), haben Verfahren der Gentechnik aufgegriffen und lebende Organismen zum Material der Kunst erklärt und transgene Lebewesen in die Kunstwelt eingeführt. Künstler der Transgenic Art und/oder Bio-Art imaginieren das Fortschreiben der Evolution durch den Menschen, bzw. die Kunst und bringen neue Lebensformen hervor, die nur mehr als „Biofakte“ bezeichnet werden können und nicht mehr einer dem Menschen vorgegebenen Natur entstammen. Mit der Herstellung transgener Organismen und techno-organischer Hybriden sind Künstler gegenwärtig an einem neuralgischen Punkt angelangt, an dem sich die Artefaktizität der Natur der Artefaktizität der Kunst gegenübergestellt sieht und so das Verhältnis von Kunst und Natur – stets das entscheidende Kriterium aller Kunsttheorie - zu implodieren scheint.*

## 1. Genetic Aesthetics

Moving beyond the often postulated dichotomy of the "objective sciences" and the "subjective arts" we see today diverse responses of contemporary artists coming to terms with the most recent scientific and technological advances. As visual experts artists translate and reassume societal or scientific issues into a visual language and conduct a visual exploration of and into other representational and signifying practices, such as molecular biology, because many artists share with scientists from these fields a common interest in life itself.

The engagement of art with science ranges today from artists' iconological handling of scientific imaging to research projects executed as artistic endeavours by artists working in the laboratory. Artists try today to decode 'scientific' images through the linking of art and the images of the life sciences, to find a new way of reading them. With the aid of an *iconography of images from science*[1], an attempt is being made by artists to decipher the cultural codes that these images additionally transport and making them recognizable as a space where other fields of knowledge and areas of culture may also be inscribed.[2] Artistic interventions in modern life sciences and genetic engineering have made possible new means of artistic expression and art forms. The use of biological materials by artists ranges from tissue engineering to stem-cell technologies and even transgenic animals, a phenomenon that raises ethical questions with regard to both scientific and artistic endeavours. But whether working with brain scans produced by advanced imaging processes or genetic engineering or simply traditional media, the focus of the artistic approach is quite often the diversity of human experience, which often does not lend itself to portrayal by standardized, scientific procedures.

New directions in research, such as those offered by neurobiology and contemporary consciousness studies, certainly provide greater insight into the working of the mind; likewise molecular biology continues to provide us with a better understanding of the structure of the living world, but today it seems to be clear, that even with the amazing insights these new worlds of scientific imaging offer us today, such images must, of course, be understood as historical snapshots, bearing within them their own historicity. The influence of these images upon our understanding of nature remains an issue of social discourse, because these new scientific explanations of the structures and processes of body and mind do, however, challenge our conception and understanding of what we call "human nature."

fig 1: Suzanne Anker: *Zoosemiotics* (1993) at the 2001 show *Devices of Wonder: From the World in a Box to Images on a Screen*, at the J. Paul Getty Museum, Los Angeles.

fig 2: Suzanne Anker: *Zoosemiotics* (1993) detail.

The New York based artist Suzanne Anker examines therefore the representational context of the respective experimental processes and the various visual preparations – DNA, for example –, which reveal more about the investigative approach of the experimenter and the circumstances of the matter than about the "matter itself".[3] Even the highly dimensional digital worlds of the sciences as part of the molecular vision remain forever loaded with cultural associations and values:

> Molecular vision has increasingly dominated the assumptions and methods of the biological sciences. Reducing life itself to molecules, it has displaced the visceral references that had once defined the authenticity of the body and the authority of traditional biology as a descriptive science. Despite the complexity of life, this vision implies that we are but a sequence of nucleic acids, a "code script" of information. This transformation of biology from organism to code and/or text parallels developments in art. Artists are adapting images revealed through hightechnology apparatus, and their pictorial and sculptural products have shifted toward the abstract. They have recognized in genetic iconography an underlying narrative that resonates with familiar forms and issues in the history of art.[4]

In her works *Zoosemiotics* (1993) and *Sugar Daddy: The Genetics of Oedipus* (1992), *CodeX: genome* (2000) and *Golden Boy* (2003) Suzanne Anker takes up the visualization of chromosomes.[5] In her 1993 installation *Zoosemiotics (Primates)* (fig. 1), which was exhibited in the 2001 show *Devices of Wonder: From the World in a Box to Images on a Screen*, at the J. Paul Getty Museum[6], in Los Angeles, Anker, was turning to visualizations of the chromosomes of various species, crossing her own visual language with that of genetics. Anker's renderings of chromosomes, enlarged and sculpted in bronze, are careful arranged on one of the walls of the gallery and on the other walls in an irregular circular pattern (fig. 2). On a delicate pedestal set out from the wall we see a glass filled with water. Viewed through the curves of the glass, the sculptured chromosome pairs installed on the wall appear entirely distorted. The intention here is not to depict the diversity and forms of chromosomes, but rather to instruct the eye in the simple optical technique of enlargement using a water-filled glass. The production here of an optical distortion serves to demonstrate the artificiality of scientific images and their dependence upon the optical media and conventions of perception associated with their respective time and age. Suzanne Anker views the visual language of the life sciences as enhanced by advanced techniques of image processing – not as "objective" and "neutral", but rather as a socially influential force, shaping the development of our identity within our society:

1 See Rhonda Roland Shearer, "Real or Ideal? DNA Iconography in a New Fractal Era," *Art Journal. Contemporary Art and the Genetic Code* 55.1 (1996): 64–69.

2 See Dorothy Nelkin and Susan Lindee, *The DNA Mystique: The Gene as a Cultural Icon* (New York: Freeman, 1995) and Donna Haraway, "Deanimation: Maps and Portraits of Life Itself," in *Picturing Science – Producing Art*, eds. Caroline A. Jones and Peter Galison (London/ New York: Routledge, 1989), 181–207.

3 See for Suzanne Ankers artworks: Barbara Maria Stafford, *Visual Analogy: Consciousness as the Art of Connecting* (Cambridge/Mass. u. a.: MIT Press, 1999), 148; George Gessert, "Art Is Nature: An Artist's Perspective on a New Paradigm," *Art Papers Magazine* March/April (2001): 16–19; Ingeborg Reichle, "Kunst und Genetik," *Die Philosophin. Forum für feministische Theorie und Philosophie* 12.24 (December 2001): 33; Ingeborg Reichle, *Kunst aus dem Labor. Zum Verhältnis von Kunst und Wissenschaft im Zeitalter der Technoscience* (Vienna/New York: Springer, 2005), 30–37.

4 Suzanne Anker and Dorothy Nelkin, *The Molecular Gaze. Art in the Genetic Age* (New York: Cold Spring Harbor Laboratory Press, 2004), 19.

5 See for this motiv: Suzanne Anker, "Cellular Archaeology," Art Journal. Contemporary *Art and the Genetic Code* 55.1 (1996): 33; SuzanneAnker, "Gene Culture. Molecular Metaphor in Visual Art," *Leonardo* 33.5 (2001): 371–375; Suzanne Anker and Dorothy Nelkin, *The Molecular Gaze. Art in the Genetic Age* (New York: Cold Spring Harbor Laboratory Press, 2004).

6 See: Barbara Maria Stafford and Frances Terpak,eds., *Devices of Wonder. From the World in a Box to Images on a Screen* (J. Paul Getty Museum, Los Angeles: Getty Research Institute, 2001), 220–222.

> Genetics is surely one of the most critical sciences at the turn of the 21st century; […] The interest among contemporary artists reflects a preoccupation with the human body, the corporal self, and the essence of human nature. In our present epoch, technologies such as genetic testing, genetic engineering, cloning, and "reprotech" all involve the transformation of the body. The growing possibilities of altering the body, tampering with nature, and manipulating reproductive processes are clinically and philosophically seductive, yet troublesome as well. They promise control and even perfection, but they also evoke fundamental questions of authenticity, identity, and bodily integrity – the same questions that, two centuries ago, inspired Mary Shelley to create Frankenstein.[7]

By the end of the 1980s, the New York artist Steve Miller had also turned his interest on scientific images in the natural sciences with a focus on neurobiology and was no longer interested in producing traditional portraits. Miller instead arranged for DNA to be extracted from bodily samples taken from his subjects; the chromosomes were then scientifically visualized and captured by Miller on canvas, as in the *Genetic Portrait of Isabel Goldsmith* (1993). In other works such as *Self Portrait Black* (1993), *Portrait of Dr. Wilhelm Frosch* (1993), and *Portrait of Jacques and Véronique Mauguin* (1993) (fig. 3) and *Origine du Monde* (1994) (fig. 4), Miller dealt with images of the organic interior of the human body:

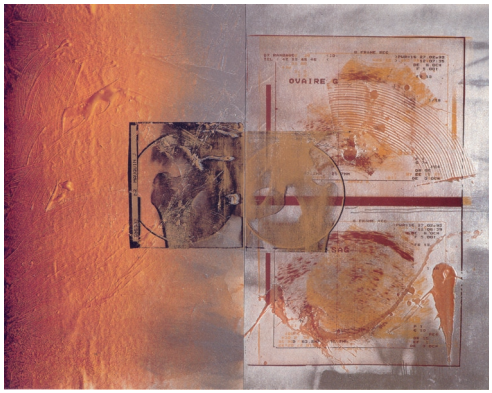

fig 3: Steve Miller: *Portrait of Jacques and Véronique Mauguin* (1993).

> In these portraits, the sitters' identity is no longer limited to outward appearance, but viewed through medical images, such as x-ray, MRI, sonogram, EKG, and CAT scans. Rather than being a depiction, these new portraits focus on identification using internal vistas and abstract symbols of medical nomenclature.[8]

The traditional genre of portrait painting, which lives from the tension between the image and its representation, is replaced in Millers works by the presumably objective image produced by the technically advanced visualization processes used in the life sciences: presented now as a *vera icon*. In contrast to portrait painting, which gives us a certain resemblance to the outer appearance of the subject, technical imagery, which brings human microstructures into view, is said to function beyond the mechanism of representation.

Artists like Anker and Miller show us, that modern life sciences and particularly the biosciences are generally characterized as mere "written technologies"; the decoding of the human DNA is surrounded by metaphors such as the "book of life" and the "readability of the world". Yet along with this staging of the body as text or even the idea of life itself in

7 Suzanne Anker and Dorothy Nelkin, *The Molecular Gaze. Art in the Genetic Age* (New York: Cold Spring Harbor Laboratory Press, 2004), 3.
8 http://www.geneart.org/miller-steve.htm (accessed July 20, 2002).

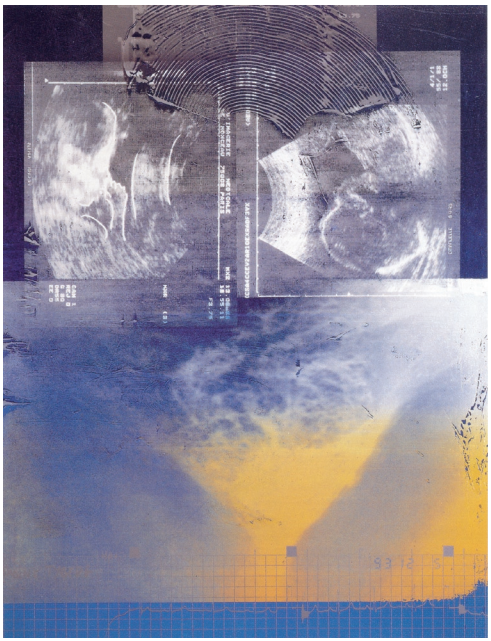

fig 4: Steve Miller: *Origine du Monde* (1994).

textual form, the biosciences are, in the practice, above all a site of enormous image production. Inevitably the question arises as to how the discrepancy between the numerous metaphors from writing and language surrounding the *life* sciences can be explained in light of the extensive implementation of the most varied image technologies. The molecular representation of life as we know it today is a product of two technological waves of development. In the first, instruments such as the ultracentrifuge, electrophoresis, x-ray structural analysis, the electron microscope, and techniques for radioactive marking and chemical analysis of macromolecules made it possible to depict components of the cell as well as molecules and to determine their chemical, physical, and biological properties. The symbol of this epoch is the DNA double helix. In the second wave, biological technologies dealing with macromolecules, particularly nucleic acid, were developed. Whereas the first phase of the development of molecular biology was set in the realm of biophysical and chemical analysis, the second phase dealt in principle with the cell and the organism itself.

Visualizations from the field of the natural sciences are never simply illustrations, but instead represent complex phenomena, which in their formulation are always bound by the conventions of representation and the reigning vocabulary style of their respective period or time. They touch upon arrangements as to the ways in which respective scientific context captures knowledge in an image and ascribes to it an epistemological meaning. Visualizations and models are without question significantly involved in the formation of knowledge and have always been an integral component of scientific efforts and legitimate heuristic means of forming theories. Although theories, however, attempt to explain concrete empirical relationships, models in the natural sciences deal much more with model-based assumptions and structural analogies. Theories can be viewed or understood as systems of evidence that attempt to adhere to assumptions about interrelationships based on strictly logical rules of reasoning and that have to stand up to empirical verification. Models, on the other hand, reflect much more in their structure the inner relationships of a problem area. Visual illustrations have always been used in the natural sciences to make visible scientific relationships, to visualize theories, or to graphically capture the results of scientific experiments. However, images and the media that transport them have their own logic and play an important role in terms of what and how we see and perceive things: Scientific visualizations arise as part of a complex interplay of different agents. They must be *produced* as part of a labor-intensive process of production and negotiation and are to a great extent *constructed artifacts* and do not simply depict or form reality and/or

the "object" of the respective investigation or experimental environment. Even photographic or other optical recording techniques do not simply record the phenomena of nature, but rather fix the state of prepared objects for the production of a visual record. Graphic representations, too, do not directly depict measured data, but rather are translated or converted into other media and visualized in diverse presentational forms that can be expressed using various representational conventions: in the form of curves, diagrams, or complex image rasters or other symbolic representations.

## 2. Life as Art - Art as life

In contemporary art today, we also see approaches that reveal the complex relationship between art and science, especially in the use of controversial technologies such as genetic engineering and tissue engineering.[9] In the last two decades we have seen a number of artists leave the traditional artistic playground to work instead in scientific contexts such as the laboratories of molecular biologists and exploring or intervening in the laboratory practices and working with the same materials and technologies as scientists do. These new approaches in art differ dramatically from those approaches which explore art and genetics through the use of traditional media. Artists create new 'life forms', i.e. new organisms which are to a greater or lesser extent artificial entities rather than 'natural' organisms. Many artists today use transgenic organisms in their works, addressing the perpetuation of evolution by humans through the creation of novel organisms according to aesthetic criteria, processes which the advent of recombinant DNA technology has now made possible. Some years ago the Paris-based art theorist Frank Popper introduced the word *Techno-Science-Art* to describe a form of art that is situated between art, science and technology.[10] This new term, which places 'technoscience' in the dominant position, seems, to be a suitable meta-term for describing these emerging, new art forms. The term *technoscience* was introduced by both Bruno Latour[11] and Donna Haraway[12] to describe the effects of the enormous transformations in the production of knowledge in the life sciences since the beginning of the twentieth century. According to Latour and Haraway, these transformations in science will lead to a redefinition of nature and science and as a consequence the term *natural sciences* will no longer seem adequate and should be replaced by the term *technoscience*.[13]

Artists turning today to the technical production of transgenic organisms or other hybrids, have apparently touched a raw nerve with the modern life

9 See: Ingeborg Reichle, *Kunst aus dem Labor. Zum Verhältnis von Kunst und Wissenschaft im Zeitalter der Technoscience* (Vienna/New York: Springer, 2005).

10 See Frank Popper, "Techno-Science-Art: the Next Step," *Leonardo* 20.4 (1987): 301–302 and Itsuo Sakane, "The Historical Background of Science-Art and Its Potential Future Impact," in *Art@Science*, ed. Christa Sommerer and Laurent Mignonneau (New York: Springer, 1998), 227. For the term „Techno-Science-Art" see the interview of Joseph Nechvatal with Frank Popper, "Origins of Virtualism: An Interview with Frank Popper Conducted by Joseph Nechvatal," *CAA Art Journal* 62.1 (2004): 62–77.

11 See Bruno Latour, *Wir sind nie modern gewesen. Versuch einer symmetrischen Anthropologie.* (Berlin: Akademie Verlag, 1995); 21 and 46.

12 See for Haraways definition of the term *Technoscience*: Carmen Hammer and Immanuel Stieß, eds., *Donna Haraway: Die Neuerfindung der Natur. Primaten, Cyborgs und Frauen* (Frankfurt a. M./New York: Campus1995), 105.

13 See Jutta Weber, *Umkämpfte Bedeutungen. Naturkonzepte im Zeitalter der Technoscience* (Frankfurt a. M./New York: Campus, 2003).

14 See for *Bunny 2000*: Eduardo Kac, "Bio Art: Proteins, Transgenics, and Biobots," in *Takeover. Who's Doing the Art of Tomorrow. Wer macht die Kunst von morgen*, ed. Gerfried Stocker and Christine Schöpf (Vienna/New York: Springer, 2001), 118–124.

15 See for the art of Eduardo Kac: Eduardo Kac, *Telepresence and Bio Art: Networking Humans, Rabbits and Robots* (Ann Arbor: University of Michigan Press, 2005).

sciences. The Brazilian media artist and theorist, Eduardo Kac, based at the Art and Technology Department of the Art Institute Chicago, operates at the interface of art and genetic engineering in his projects *GFP K-9* (1998), a bioluminescent dog, *GFP Bunny* (2000)[14], a green-glowing rabbit, and the installation *Genesis* (1998–1999).[15] With these works, Kac puts up a new art form for debate: the concept of Transgenic Art.[16] By creating transgenic[17] animals and integrating them domestically and socially, it is Kac's declared intention to draw attention to the cultural effects and implications of a technology that is not accessible visually and bring these to the public's attention for debate.

> Molecular genetics allows the artist to engineer the plant and animal genome and create new life forms. The nature of this new art is defined not only by the birth and growth of a new plant or animal but above all by the nature of the relationship between artist, public, and transgenic organism. [....] There is no transgenic art without a firm commitment to and responsibility for the new life form thus created. Ethical concerns are paramount in any artwork, and they become more crucial than ever in the context of biological art, when a real living being is the artwork itself. From the perspective of interspecies communication, transgenic art calls for a dialogical relationship between artist, creature/artwork, and those who come in contact with it.[18]

Using biotechnology, Kac transfers synthetic genes to organisms and natural genes from one species to another. Projected is the creation of originals, unique organisms. In his installation *Genesis*, Kac attempts to make biological processes and technological procedures visible, which for years now have been standard practice in research laboratories.[19] In a dark room, a brightly illuminated petri dish stands on a pedestal (fig. 5). A video camera, which is positioned above it, projects an oversize image of the dish onto the wall. Ultraviolet light falls onto the petri dish and the intensity of the light can be controlled by the visitor via a computer. This can be done either in the gallery or via the Internet. In this way the users can influence the processes of replication and interaction of the bacteria in the petri dish and observe these in the magnified projection on the wall or on the Internet — processes, which normally can only be seen under a microscope (fig. 6). Thus the role of the observer is enhanced to that of active participant, who is able to intervene in the processes and influence the course of the work's presentation. The focus of the installation is a synthetic gene created by Kac, a so-called "artist's gene". This process, which would normally take place only within a laboratory, Kac has transferred to an art gallery. With his Transgenic Art, Kac wishes to draw attention to the cultural implications of

16 See Eduardo Kac, "Transgenic Art," *Leonardo Electronic Almanac* 6.11 (1998).

17 "The word 'transgenic' is used to refer to an organism whose cells contain exogenous DNA. There are two dominant distinctions: whether the DNA is integrated into the host's chromosome or not (transient vs. stable transgenics) and whether or not all of the cells of the organisms contain the DNA (mosaic vs. non-mosaic). Often the term 'transgenic' is only used for the case where DNA was integrated into the host genome and is present in every cell in the animal, a situation best confirmed by passage through the germ line. However, it is equally appropriate to think of animals in which only some cells contain the foreign DNA, which may or may not be stably maintained, as transgenic." See Adam Amsterdam and Nancy Hopkins, "The Use of Green Fluorescent Protein in Transgenic Vertebrates," in: *Green Fluorescent Protein. Properties, Applications, and Protocols*, ed. Martin Chalfie and Steven Kain (New York: Wiley-Liss, 1998), 222.

18 Eduardo Kac, "Transgenic Art," in: *LifeScience. Ars Electronica 99*, ed. Gerfried Stocker and Christine Schöpf (Vienna/New York: Springer, 1999), 289.

19 Eduardo Kac, "Genesis," in *Gail Wight „Spike" Eduardo Kac „Genesis"*, ed. O.K Centrum für Gegenwartskunst, ed. (Ars Electronica. Cyberarts 99. Linz, 1999), 50–59.

biotechnology and its possibilities for transforming and manipulating life.

> [...] it is equally urgent to address the emergence of biotechnologies that operate beneath the skin (or inside skinless bodies, such as bacteria) and therefore out of sight. More than make visible the invisible, art needs to raise our awareness of what firmly remains beyond our visual reach but which, nonetheless, affects us directly. Two of the most prominent technologies operating beyond vision are digital implants and genetic engineering, both poised to have profound consequences in art as well as in the social, medical, political, and economic life of the next century. [...] In the future we will have foreign genetic material in us as today we have mechanical and electronic implants. In other words, we will be transgenic. As the concept of species based on breeding barriers is undone through genetic engineering, the very notion of what it means to e human is at stake. However, this does not constitute an ontological crisis. To be human will mean that the human genome is not a limitation, but our starting point.[20]

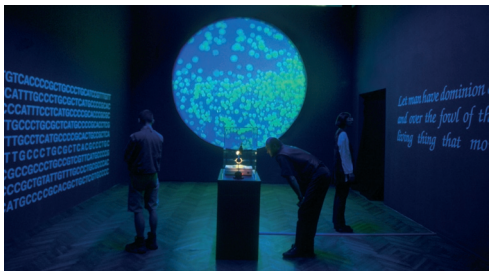

fig 5: Eduardo Kac: *Genesis* (1998–1999) at the Ars Electronica Exhibition in 1999 in Linz.

All the while, the laboratory methods used to manufacture these "artist's genes" are not in any way new. For more than three decades, genetic engineering techniques from the field of molecular biology have made possible the technical reproduction of life at the molecular level. These organisms, until now non-existent in the natural human world, no longer resemble any natural evolutionary architecture and reinforce the transformation of biology lab organisms into *epistemic objects*.[21] Molecular biology as well as other fields in the life sciences to a large extent construct and design the objects of their research today themselves, thereby producing technological artefacts which owe their existence to the culture of experiment and the expanding technological systems of the laboratory. At the same time these organisms in the laboratory often now have an epistemological status in terms of knowledge models that merely serve as representational models. In this way the technofacts of the 'third nature' have, today, to a large extent replaced life forms of the first nature as the reference objects of the laboratory.[22] Reports of experimental results as well as the discourse of research organisations are therefore primarily focused on these manufactured, epistemic objects, whose modelling takes place within the immense science complex and the physical infrastructure of the laboratory. Such an implementation of model realities without a reference makes possible a controlled technical manipulation of the processes of life, which then leads to a denaturalisation or artificiality of the object under investigation.

The development in the 1970s of recombinant DNA technology led to a fundamental change in the way molecular structures and processes of

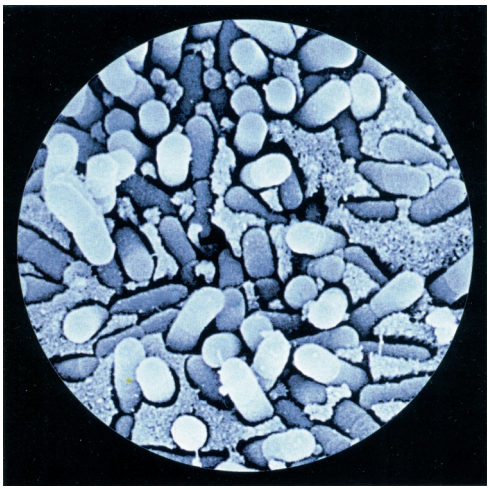

fig 6: Eduardo Kac: *Genesis* (1998–1999), detail.

living organisms could be made available for scientific experimentation. With the production of transgenic organisms, molecular biology moved beyond the current borders of species and subspecies that are a result of millions of years of evolutionary change, thereby shaking up the existing system of scientific classification. From an epistemological perspective this new access to organisms represents a break with previous methods and approaches in molecular biology: Macromolecules themselves became manipulative tools of recombinant DNA technology and thus were transformed into *technological entities*. The nature of these is such that they are no longer distinguishable from the processes in which they intervene, and in the molecular biology lab they begin to resemble industrial production systems, becoming in effect *molecular machines.*[23] As a consequence of this development the organism acquires the status of technological object; the organism or even the molecule itself becomes a laboratory.[24] The entire range of modern life sciences are on their way to becoming a new science that not only treats, dissects, processes, analyses, and modifies its materials – living organisms and parts thereof – but rather constitutes and constructs these as *biofacts*, which can no longer be described as being a part of a "natural nature".[25] This construction, however, does not correspond to an understanding of the production of matter as a form of 'creation' in the sense of the bringing forth or generation of life, but is rather to be seen as a process of transformation and conversion of matter.

The neologism *biofact* – combining "bio" with the term "artifact" – was developed by the philosopher Nicole C. Karafyllis as a hermeneutic concept, which allows to ask for the differences between „nature" and „technology" in the area of the living.[26] „Life" thus is examined by her in an intermediary perspective between subject and object and is outlined by reflecting on the term „growth", because not only by recent biotechnological progress, where „life" is regarded as a quality applying to epistemic objects within scientific categories, but also by the anthropological concept of hybridity, the borders between the natural and the artificial become vague on the phenomenological level: Artifacts are artificially devised and created objects. Constructed things were until now always in the category of objects. An artifact, referring to something man-made, serves as a collective term for such diverse, artificially created objects as buildings, art works, and machines. Artifacts generally are dead or inanimate. *Biofacts* are biotic artifacts; that is they are or were once alive. The categorization of the technical treatment of life is certainly not new, nonetheless there was until now no systematic term to include the technological manipulation of original natural growth. This terminological lack occurred, among other reasons, because philosophy of

20 Eduardo Kac, "Transgenic Art," in *LifeScience. Ars Electronica 99*, ed.: Gerfried Stocker and Christine Schöpf (Vienna/New York: Springer, 1999), 293.

21 See Klaus Amann, "Menschen, Mäuse und Fliegen. Eine wissenssoziologische Analyse der Transformation von Organismen in epistemische Objekte," *Zeitschrift für Soziologie* 23.1 (1994): 22–40.

22 See Jürgen Ritsert, *Einführung in die Logik der Sozialwissenschaften* (Münster: Westfälisches Dampfboot, 1996), 338.

23 See Karin Knorr Cetina, *Wissenskulturen. Ein Vergleich naturwissenschaftlicher Wissensformen* (Frankfurt a. M.: Suhrkamp Verlag, 2002), 199.

24 Hans-Jörg Rheinberger, "Kurze Geschichte der Molekularbiologie," in *Geschichte der Biologie. Theorien, Methoden, Institutionen, Kurzbiographien*, ed. Ilse Jahn et al (Heidelberg/Berlin: Spektrum Akademischer Verlag, 1997), 661.

25 Vgl. Klaus Amann, "Menschen, Mäuse und Fliegen. Eine wissenssoziologische Analyse der Transformation von Organismen in epistemische Objekte," *Zeitschrift für Soziologie* 23.1 (1994): 25.

26 See Nicole C. Karafyllis, "Das Wesen der Biofakte," in *Biofakte. Versuch über Menschen zwischen Artefakt und Lebewesen*, ed. Nicole Karafyllis (Paderborn: mentis Verlag, 2003), 12.

technology focused, first of all, on systematically classifying technology and always viewed nature as 'the other' and the 'opposite' of technique, something from which one could distance oneself.[27]

## 3. Art, Science and Society in the Genetic Age

The transfer of scientifically produced transgenic organisms from the laboratory into the gallery space in the last few years has led to passionate debates which tend to focus less on the status of such objects as works of art and much more on ethical debates about the limits of manipulation by the natural sciences of the unadulterated natural world and its economisation by business. At the same time there has been reoccuring criticism of the 'artistic' production of living organisms according to aesthetic criteria and without any considerations of use or purpose, as opposed to the work of scientists in fields such as molecular genetics or cell biology. Art was seen as transforming such life forms without legitimate purpose or reason into aesthetic artefacts, wanting thereby to rewrite the story of Creation for its own outrageous purposes. It thus became clear that the public is not yet ready to accept 'glowing dogs' and 'glowing rabbits', which are viewed as eerie and monstrous hybrid life forms not belonging—not permitted to belong—to the creature world, where their presence would lead to disarray within the traditional, ontological orders. With regards to the production of new hybrid forms in art, it seems to be less a debate about the acceptance of new art forms or shifting borders in the art world itself; much more significant are the negotiation processes of the forces shaping society, forces which can lead to the contruction of very specific life forms and worlds, thereby excluding others. Living things that are manipulated and modified in laboratories for specific scientific or economic purposes, will, to a certain extent, be accepted, but not, however, in day-to-day life. This all the more so since in the course of the *mechanisation of the living* it is becoming ever more difficult to determine what is still 'nature' and what is already technology, what can be regarded as real and what is imaginary; the certainties of the daily world have already been severely shaken.

While more traditional epistemological viewpoints, focussed on the idea of the organic, continue to persist in the old 'humanistic' connotation of nature, regarding nature as static, abiding, and more or less endowed with inalienable properties, and while postmodern epistemology continues to concentrate on deconstructing the accompanying classical humanistic categories, the biosciences ceased operating with this humanistically

understood idea of nature some time ago. New art forms emerging from the lab show the world how precarious the category of 'nature' appears today and how great the fear is that the results obtained in the laboratory with artificially created technofacts and epistemic objects will, in the *Age of Technoscience*, as a rule, be applied to other organisms and eventually humans. These fears, in light of the tremendous speed with which the technosciences are developing, are well justified. Furthermore, on account of the increasing amalgamisation of technology, industry, and science today, one can barely distinguish between the technical, social, economic, and political factors that are responsible. The extent of the current ubiquitous 'scientification' and mechanisation leads furthermore to the situation that technology will become increasingly constitutive for social structures and processes—a situation which, according to recent scientific research, will lead to a fundamental transformation of the constitutive social structures.[28]

The emergence of new technologies and their implementation in contemporary society is by no means a smooth process, but rather takes place within a complex and multilayered interplay of forces and interrelationships among science, technology, and society, and is accompanied by a constant process of social negotiation. In the course of these negotiations for the world of tomorrow, the life sciences in particular continue to develop new human models and are becoming increasingly involved in the social-political debates. Yet it was the emancipation of the natural sciences from such meaning-of-life questions that was one of the fundamental prerequisites for their advancement in the modern age and their increased effectiveness. The focus on answering purely analytical questions and the referral of enquiries into values, norms, and meaning to the areas of theology, philosophy, and other humanities and social science fields, formed the initial basis for—particularly in the context of economically useful results—the tremendous rise of the empirical sciences. The delegation of such questions of ethics to the humanities and social sciences in favour of the development of a purely pragmatic operating basis for the 'feasibility' and 'realisability' of theoretical approaches was one of the fundamental conditions for the powerful social position which the natural sciences have attained over the last two hundred years.[29] For this reason as much as any, the resulting differentiation of the sciences and university disciplines led in the end to a final separation of the humanities and natural sciences as well as to an ever increasing fragmentation of a disenchanted world in which a comprehensively conceived concept of life and nature no longer seemed possible, and brought with it the splitting up of the concept of nature into numerous fragmentary aspects. In the course of this development, the concept of nature and

27 See Nicole C. Karafyllis, "Das Wesen der Biofakte," in *Biofakte. Versuch über Menschen zwischen Artefakt und Lebewesen*, ed. Nicole Karafyllis (Paderborn: mentis Verlag, 2003), 12.

28 See Günter Ropohl, *Technologische Aufklärung: Beiträge zur Technikphilosophie* (Frankfurt a. M.: Suhrkamp, 1991), 184.

29 See Cornelia Klinger, "Der Diskurs der modernen Wissenschaften und die gesellschaftliche Ungleichheit der Geschlechter. Eine Skizze," in *Wissenschaftlichkeit und Verantwortung. Die Wissenschaft – eine Gefahr für die Welt?*, ed. Heinz Barta and Elisabeth Grabner-Niel (Vienna: WUV-Verlag, 1996), 115.

the interpretations thereof being put forth by the natural sciences in the technological community in particular were increasingly granted an ever greater significance. In contrast to this, metaphysical ideas of nature were now disqualified as speculative, therefore non-scientific, and—above all—of no profitable use. In this manner, the history of natural *research* and the history of natural *ideas* came undone. Non-empirically structured ideas of nature became simply decorative, theory-oriented aspects of a general education in a culture otherwise shaped by the 'essential', result-oriented, intersubjectively operating natural sciences.[30]

Science, engineering and technology shape the world in which we live, but artists show us the role played by art in the ever more complex interplay of forces between science, technology and society. From the end of the nineteenth century onward, art has increasingly turned away from the classical quest for order, and has struggled on many levels with the disintegration of a uniform world view and a coherent conception of humanity. It is the artist who asks about the social effects of scientific developments and challenges the changing scientific concepts of life itself — these questions become ever more urgent with every scientific advance. Moving beyond the postulated dichotomy of the objective sciences and the subjective arts, many contemporary artworks show us that art is no longer limited to the production of beautiful artefacts, but has established its role as a legitimate form of knowledge production in its own right.

30 See Jürgen Mittelstraß; „Leben mit der Natur," in *Über Natur: Philosophische Beiträge zum Naturverständnis*, ed. Oswald Schwemmer (Frankfurt a. M.: Klostermann, 1991), 50.