General Studies Lectures: Engineering Towards Development and Change

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Cultural Philosophy and History of Productive Life

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1. Introduction: Cultural values as the basis for productive life

Technology since the ancient times (Aristotle) was regarded to be the *opposite* of nature. So technology was a concept of "othering" nature. It was the overall tool to get rid of nature`s boundaries by means of human intelligence and productive creativity. In modern times, especially in the 19th century, the idea came up, that there is not a dichotomy of technology and nature, but of *culture* and nature. Culture was reframed in terms of *civilization*, i.e. educating the wild and untamed nature. It was also used to build a hierarchy of higher and lower cultures, based on colonialism and nationalism. Because of its elite thinking, it was ignorant of mass and popular culture. This view was also effecting the evaluation of the different professions and university disciplines within Western culture. Especially the philosophy of idealism canalized the view, that technology was regarded as something non-intellectual, something for the lower social strata of craftsmen and engineers. Technology was not for thinkers. Other than historians, poets or philosophers, the engineers seemed to belong to "low culture". Subsequently, engineers were not allowed to be part of the normal university curricula until the late 19th century.[1]
Of course, these times are gone. Engineers today shape the world with their inventions and thus are a pacemaker *of* different cultures and *within* different cultures. They contribute to both mass products for a global world and single best technological solutions, making the best available technology real.

In my talk, I will stick to the ancient divide between technology and nature, and analyze why exactly this antithesis is still needed for making up a unique culture. We will see that philosophy and technology need each other in many respects.
First, I will have a look at what means "productive life". Productivity is a measure relating a quantity or quality of output to the inputs required to produce it. But which quantity is measured in relation to what? You can e.g. measure the hours of labour in order to produce a computer. Or you can measure the months of pregnancy in order to produce a child. In the later sense, human beings are not very productive, compared to insects.
Here the question how qualities of life can be measured comes up; and if it always makes sense to measure quantities without the related qualities. This is an ethical question. Where people agree on a common definition of value, they may agree on a definition of productivity. So, within a discipline, there might be agreement, as it is often within economics and technology development. There, efficiency might be the most important "value" to consider. Anyhow, when technologies are applied, they leave the sphere of the university, company or laboratory, and interrelate with society. The pluralism of cultures is but one of the reasons why other than economic concerns have to be taken into account in advance, that means *before* the product is on

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[1] It was France which introduced the polytechnic schools in the last third of the 18th century.

the market. Very often it is due to a lack of considering the regional and national values that a good product does not hit the market.
A good example is the technology of genetic engineering of food plants in Europe. As productivity is measured as a ratio of output per unit of input over time, GM-crops seem to be more productive than the conventionally bred plants. By genetic engineering they are made suitable for the use of special herbicides, which guarantee higher harvest rates. As Ethiopia's Gross National Product is based up to 50% on agriculture, I will focus my talk on the new technological shifts which intermingle with plant production.
Until now, the European Union struggles with the customers' aversion to buy these products. Moreover, people do not even want these GM-plants (GM: genetically modified) to be grown on the European fields. Africa is seen as a field of experimenting with these kind of transgenic plants by many big companies.
In the 1990s, there was a strong astonishment about this European lack of acceptance, because in the US the people are not much concerned about GM-plants and the related products. So why are they in Europe? The question is not answered yet, but it has something to do with the different attitudes towards nature and towards the beginning of life. In all cultures which are founded on Greek antiquity and monotheistic religions, the plants demarcate the beginning of life. You find these passages both in the Bible and in the Quran. With plants, the life itself starts. Animals and humans follow the existence of plants.
So when we ask about the relationship between technology development and productive life, we today know that the life of a plant has got something to do with the life of human beings. For technology there is a lesson to learn from that.

2. Technology, Nature and Life

So technology is encroaching on nature and most of all: on life.[2] While the manipulation of living beings is already known from the ancient practice of breeding (Zirkle: 1935) and is regarded as unspectacular, new technologies such as cell cultures, organ transplants, reproductive medicine and computer simulation of biological processes call into question our traditional distinctions between nature and technology. What makes up the difference? Traditionally, *growth* is distinguishing something as "living" and as "nature". My talk will focus on this importance of growth and its modelling for science in the context of application. It is about entities and types of entities developed by the life sciences in a broader sense, including computer science. The phenomenon growth mediates between two different kinds of "worlds": the scientific world of generating *biofacts*, and the life worlds of common sense, cultural heritage and every day experience, suggesting *hybrid identities of the living*. The human being is a hybrid between technology and nature. A tool-maker, a designer, but nevertheless having a body and soul, and depending on processes of growth.
I'd like to stress the different ontologies between these two paradigmatic worlds – the life world and the laboratory world - , this is why I suggest the term "biofact" for the epistemic sphere of the scientific world. Any ontology must give an account of which words refer to entities and which do not. That means it also marks a space, which is unseen and unknown as well including the processes happening within.

3. Biofacts

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[2] This article contains some of the main theses I developed in my habilitation project (Karafyllis: 2006a).

The term 'biofact' is a neologism[3] comprised of (gr.) '*bios'* and 'artifact'. 'Biofact' refers to a being that is both natural and artificial. It is brought into existence by purposive human action, but existing by processes of growth. Why do we need a new term? The term *biofact* can account for the influence of technology on natural forms of growth (resembled in certain species). It allows for reflection on the existing borders between nature and technology, when it comes to designing practices of life. Conventional terminologies of designed living entities originate in different disciplinary and everyday contexts, ranging from agriculturally based practices to the science fiction film genre. Here are some of them: bastard, genetically manipulated organism (GMO), chimera, clone, replicate, cyborg etc. This complicates their employment as terms in a scientific context. By contrast, 'biofact' is a neutral term that can contain a wide spectrum within the two poles: natural living entities and technical artefacts. It shows that 'life' is not a secure candidate within the category of nature any more and that not only construction, but also growth is a medium for design. You cannot only build houses, but you can "build" organisms, so it seems. Human action and natural growth interfere in the act of designing, producing cloned individuals as well as biomaterials.
The interesting point is that for the design process of living objects the activity duration is *determined* by growth, not by human action. Due to the reproduction of cells, life of former living entities is always a precursor of the design process to be established.

Let's turn back to ancient times: Aristotle said in *De anima* – his masterpiece *On the Soul* - that whatever grows is natural, and hence 'life' can be identified with nature, starting with the activity of plant soul (lat. *anima vegetativa*). Somehow in contrast he stated in his *Physica*, whatever is moved externally is considered *technē*. This antithesis corresponds to our common sense intuitions: trees, children and hair grow, whereas machines and other tools do not. In addition, self-moving automatons do not convince us that they are natural, even if they have held the illusion of having body-like features for many centuries and still inspire technological visions of 'man-machines' (Orland: 2005). However, do these distinctions still hold today in the light of recent advances in biological and biomedical technologies, moreover nanotechnologies, melting into the socalled Converging Technologies?
I will argue that they *do* still hold today, but that in recent decades the distinctions have become much more hidden than before, first of all through the genetic design of living objects in laboratories. A laboratory is a detached sphere of changing natural entities to living prototypes. The prototypes are copied and released as products into the public sphere afterwards. The discourse on Green Genetic Engineering in Europe shows that for instance in the agricultural context both worlds, the scientific one and the one of every day experience, here meet in a conflictive way. Transgenic maize and soybean, planted into the public sphere, do not show their technical manipulation, they still seem to be natural. They are not robots with iron and cables, they are just a little bit more "perfect" than the plants we used to have.
How do you get to know about their "true nature"? You have to *inform* yourself if the plant you see and the product you buy is grown without technical manipulation or not. You have to ask an expert. Due to this epistemic 'veil of ignorance' in society, a third status between naturalness and artificialness, which I call *biofacticity*, is made plausible. With that term I want to stress, that the intuitive connection between the science of biology and the topos of "nature" is fading away.

[3] In the meantime I found out, that the term biofact was once used by the Austrian taxidermist Bruno M. Klein in one publication (1943/1944), in order to stress that living entities produce "dead" structures like wood or limestone shells. As far as I know, this publication has completely been forgotten and thus the term has never been quoted again.

Biology today becomes technology, where the life world is in the focus of designing their living beings.
This *might* also be a result of the economic pressure on bioscientists to produce effective and efficient organisms. A new term developed for the context of application, called "biocommerce". The technical term for the related kinds of organism-prototypes is "high value/low cost-organisms". At present, there exist a lot of databases concerned with the business aspects of biotechnology and the commercial applications of biological sciences worldwide, often on the university campus, including competitor monitoring, identifying product licensing opportunities, monitoring legislation and case law in the relevant fields.

Let us "dive" into philosophy for a while. The invisibility of what makes a difference between nature and technology is at least threefold, concerning language, scientific models and anthropological presuppositions. The first type of invisibility refers to *language* in the scientific context, because growth is renamed with technical *metaphors*. Outside the laboratory you see the opposite procedure: biofacts are marketed as natural products. Here we can see the old question in philosophical ontology: Aristotle voted that the experience with things, the *empireia*, makes up the ontological categories. It is a phenomenological approach. The constructive ontology since Kant focussed on language for substructuring the world into categories, the world then has to fit into. The term biofact can address both approaches: first, the word gives an advice that bioscience should be aware of *not* constructing living *beings*, but something living which is near to artefacts. Second, the import of living beings from the life world, the remodelling as organisms and the export of manipulated organisms back into the life world should be resembled by a specifying term. Because the border of the two worlds have been crossed, even if nobody can see that anymore.
The second type of invisibility can be found in the epistemic *models* of growth in Converging Technologies, as e.g. networks and model organisms, which already focus on design of life. The third type of invisibility is hidden behind a lack of *anthropological* discussion, concerning what human life actually is and, moreover, should be in a subject perspective of hybridity (Latour: 2002).

With 'biofact' a hermeneutic concept is developed, which allows to ask for the differences between 'nature' and 'technology' in the area of the living. 'Life' thus is examined in an intermediary perspective between subject and object, and is outlined by reflecting on the term 'growth'.

4. Metaphors of Growth and Growth Categories

Growth is the necessary presupposition for both: *starting* biotechnical design activities and bringing them to *appearance*. It functions as antecedens and mode of continuity of a self, exceeding the status of a mere material conditional. What makes 'growth' an interesting term from a philosopher`s point of view is that the categories of cause and reason seem to melt into one. This means, growth affects the relation of 'nature' and 'culture'. In Aristotle's works, growth is a special kind of an overall movement of the *physis* and thus reserved for the topos of nature. It includes coming into being (gr. *genesis*) and fading away (gr. *phthisis*) – and thus is strongly related to the living. Aristotle interprets growth both quantitatively (increase/decrease) and qualitatively (coming into being/fading away), which can be understood as an objective versus a subjective view on 'life' in a modern reading. On a meta-level, both perspectives are

connected by the category of change (gr. *alloiosis*) and by the ontological concept of substance (gr. *ousia*), which always holds its own potentials from the very beginning (gr. *arché*) of being.
Since the early modern times the concept of substance was reduced to (lat.) *materia*, which corresponds with a form open for designers to some extent. Biotechnological progress could and can make use of specific quantitative and qualitative changes of organismic growth patterns. But this design still is embedded in organism-specific growth types and limited by the birth and death of living entities. Further more, growth in modern biology is dealt within evolutionary thinking. Its teleology is economic.

When we look at the biological understanding of growth, we find different terms, e.g. increase (of cell volume and cell number), morphogenesis, differentiation, negentropy and complexity (Karafyllis: 2002). They are inspired by theories of various disciplines like physics and engineering, and biological sub-disciplines like genetics, physiology and embryology. Until recently, the humanities have employed concepts of 'nature' and 'life' that ignore the problematic notion of growth in biology, and the biological sciences continue to operate with a concept of growth which is neither unified nor comprehensive. Today it is common in Life Sciences to differentiate between 'growth' and 'development', resembling a distinction between quantitative and qualitative characteristics of life, which in reality never can be found.

Due to the recent success story of genetics, meaning a research program of analyzing and designing mainly qualitative characteristics of organisms while they develop, 'growth' is understood in a reductionistic manner and is by now a *dead metaphor* in Life Sciences. This means that the use of related terms like 'increase' or 'proliferation', by which growth is explained (as *explanans*), implies a common sense notion of what growth actually *is*; but that at the same time in epistemic contexts this notion is reduced to model and provoke processes, which always already show growth as presupposition of a continuity of being (as *explanandum*). Due to the fact that we are somehow very sure, what growth is, it is not called into question for connecting 'the natural' and 'the living' in modern times. Behind this circular epistemic argumentation we find the ontological problem of how to decide, if something is actually growing and, hence, if something is actually living. Synthetic biology nourishes the doubts, if the connection of growth and live is still a necessary one. Maybe, one can assume, it could be replaced by aggregation of particles, which end up in resembling an organism.

However, 'living' means a state of being which is more than just to be alive. 'To live' implies a biography, leading to a referable starting point and its spatial and temporal determination. Already Aristotle had an ontological problem with the permanent growing, but non-perceiving plants. In *De anima* he assumed plants to be 'living things' (gr. *zonta*), and not (gr.) *zoa*, i.e. real living entities like animals and humans. Nevertheless all living things were united by the idea of the soul (gr. *psyché*).

According to Max Black (1968), theories of metaphors can be interpreted respectively in the sense of *substitution*, *comparison* or *interaction*. For our purpose, the interactive approach is the most useful for questioning how far 'growth' refers to a 'real' living entity or is used as metaphor for any kind of continuous process with inherent possibilities of change. The thing, which is named and the word to name it, interact with a certain fluidity, depending on the explanatory context. Depending on *what* is to be explained, the metaphors function as clarifying filters. Technical and economical metaphors in biosciences thus make the idea of growth and productive life comprehensible for the cultural sphere, in which persons regard themselves as having control over the means and ends. They serve not only for explanation, but also for justification of envisioned ends (Pörksen 2002).

Experimental science can both name and stimulate biological growth in such a way that only the abstract starting point of genesis remains as 'nature'. Whatever grows can equally well be understood as artificial, depending on the feature taken as characteristic of growth, e.g. increase or reproduction, and depending on technical terms, e.g. ‘functions’ and ‘tools’, which are used to describe and model cells, tissues and organs.

To postulate that something is growing can be understood in different ways. One is to use ‘growing’ as *alienans*, i.e. as an adjective that appears to be qualifying a subsequent description. But it functions while leaving the question open of whether the description applies, like e.g. ‘a near victory’. The potential of a specific entity is emphasized as well as the possibility of a certain outcome, e.g. when we say that lizards can regenerate their tails by the means of growing cells. Observing that lizards have the potential of totipotent growth in some of their tissues, one can assume that they *will* actualize it, once their tail is cut.
Another is to use ‘growing’ as substitute for ‘living’, referring to the continuity of process that implies the overall estimation of what living entities, and not only lizards, in general do. In the second context, background theories of evolutionary thinking become important, determining the overall growth type in which species and organisms are tokens. The instance of this type-token-relation is the reproduction of organisms and biological species, guaranteeing both identity and alterity of the process.

To sum it up: the term ‘growth’ is used in Life Sciences in a threefold sense, building distinct categories with different theoretical backgrounds, but all referring to cultural history:

- Reproduction
- Regeneration
- Permanent and persistent Growth (Process/Progression)

All three types can best be demonstrated by *plants*, which always have been a cultural symbol for growth. They lack a limited body with skeleton and central organizing units like heart and brain, and, after they have died, do not leave a (lat.) *corpus*, but decay. Trees are somehow an exception and were always handled separate in natural philosophy, as were carnivorous plants. Because trees leave a corpus, because they are able to overcome gravitation by growth and because their life time exceeds the average human life span, Aristotle regarded them as the highest forms of the vegetative soul. With plants “life” begins. ‘Reproduction’ was and still is also called ‘Fortpflanzung’ in German language, meaning a continuous repetition of something *planting* itself. Neither ‘offspring’ nor ‘proliferation’ emphasizes this plant characteristic of growth, which also is used on animal and man: planting a self without *being* one.
‘Regeneration’ also is a characteristic of plants. The organisms which showed regeneration after being cut, like the polyp *Hydra* spec., were until the late 18th century regarded as plants. If we say, that something regenerates, we apply a *teleologic* understanding of growth, i.e. a growth resulting in a specific end. On the contrary, ‘reproduction’ in a modern sense just refers to copies of an organic self, which remains productive in order to produce more. Here the most problematic term behind is ‘identity’. Only plants are able to reproduce asexually by cloning, making genetically identical copies.
Finally, permanent and persistent growth is the ideal type of unlimited growth, which some trees (Oak, Sequoia) show for many hundred, sometimes a few thousands of years. As evolutionary ‘tree of life’, famous especially by the publications of Ernst Haeckel (Bredekamp: 2005), permanent and persistent growth, which keeps being rooted in a beginning, means a genealogic view of life as a whole. It is a process which will be altered, but never is supposed to cease.
In the laboratories of the Life Sciences, these three categories of growth intermingle, when ‘life’ is designed and ends up in biofacts – and so do their metaphorical backgrounds. The cultural metaphors of growth also can be seen in the economic campaigns for investment funds. The

diagrams of growth curves are combined with plant images, to show that the capital growth will end up in something, that makes sense, something that has a fruitful outcome.

Genetic methods very often require a specific phenotype before they can be carried out, a so-called model-organism. Famous model organisms are the yeast Saccharomyces *cerevisiae*, the fruit fly Drosophila *melanogaster*, the mouse (Mus *musculus*) and the wall cress Arabidopsis *thaliana*: Arabidopsis it's *the* model plant, belonging to the mustard family. For these model-organisms the genome is completely sequenced (as it is for Man since 2001) and there exist genetic libraries, with different mutants, vector systems and peptides ready-at-hand. All laboratories in plant research work with Arabidopsis and their mutants. Arabidopsis can reproduce either vegetatively or sexually, you can regenerate a whole plant from just one leaf, and because of its rapid seed production, it's reproduction nearly never ceases. In Arabidopsis, all three growth types fall into one.

5. Growth as Medium and Mean: Network Modelling and Model-Organisms

Growth can be understood either as *medium* or as *mean* (in the sense of 'tool'). The same is true for technology (Gamm: 2000, Hubig: 2004). As medium, growth still is a natural process containing substantial potentiality and supporting the emanation of something living. The form of a living thing in nature is reached *by* and *through* the medium of growth. When growth becomes a mean, the form is still reached through the medium of growth, but not by it. As a mean, growth also has to be manageable enough to reach a certain end. By standardizing cultivation techniques with artificial culture media, e.g. as soil- or skin-substitutes, and encoded proteins, stored in gene banks as implementable 'information'[4], biosciences have come near to use growth as a tool. Nevertheless growth remains, using Martin Heidegger's distinction, a tool which has to be both: *ready-at-hand* ("Zuhandensein") and *presence-at-hand* ("Vorhandensein"). In different stages of the design process growth is either ready-at-hand (e.g. in mapping genes of cultivated organisms, i. e. *before* the entity to be designed comes into existence) or presence-at-hand, when the growing entity already exists (within practices of breeding and growth control, e.g. the use of growth hormones). To make a growth type becoming presence-at-hand, its reduced substantial counterpart (a gene), has to be implemented in a nourishing and stimulating context (e.g. a denucleated egg cell). Only together can something living result.
From philosophy of science point of view, there are four epistemic stages, by which biofacts are made ready-at-hand for design (for details see Karafyllis: 2006a). Growth is at first reduced to its material compounds and substituted by movement and functional form, and at second brought back into reality by plantation techniques (im-, ex- and transplantation).

1. Imitation
2. Automation
3. Simulation
4. Fusion

Imitation allows to focus on a certain growth state, in general the one regarded as grown-up, and the plan to design it as (gr.) *mimesis* of nature. In order to do so, the substantial growth potential of the entity has to be fixed into a material state, a 'building mass'. Automation reanimates the

[4] In this specific sense 'medium' is used in a different way, i.e. as a mere *carrier* for information without own process capacities.

thing by movement of the selected automation components that can be interpreted functionally (idea of 'the organic', see Köchy: 2003). Computer simulation dematerializes the growth process and virtually envisions a complete automation of the specific growth type, which by then has lost its entity. Finally fusion in the biotech-laboratory works with model organisms as media *and* means, and has to prove if the modelling process can be made *real*. A typical media-and-mean-system consists e.g. of plant and bacteria, or plant and yeast. Real is a *living* thing only if it has *actuality*, i.e. if people dealing with it sometimes experience any kind of resistance in their practical work. This definitely is true for working with living objects in the laboratory, where only a small percentage of individuals of a model-organism are normally able to "auto-activate" the implemented genetic structures. The type of action making two entities fuse can best be described by *provocation*. Provocation is the key instance for fusion – the last step of making biofacts.

But provocation is expensive, because its outcome is insecure. Evelyn Fox Keller (2005) recently pointed out, how *bioinformatics* shape new epistemic models for the life sciences, first of all in the context of application in medicine, e.g. in cancer research. The pioneer of *random scale-free networks*, Albert-László Barabási, published the idea, that there are teleologic „open" networks, which follow a *power law distribution* in 1999, together with his colleagues (Albert et al.: 1999). He was inspired by the distribution of *hyperlinks* (of so-called „*hubs*") in the *World Wide Web* and used it for giving the mass of new data, collected by the Human Genome Project, an interpretative structure for the new field of proteomics. Bodies, cells and networks are treated analogously in order to model probable functions, arising from protein-protein-interactions. This solves the problem of proteomics, how to find functions for genetically encoded proteins, to a certain extent. Soon after Barabási's publication, scientists working in the area of cancer research wrote about the tumour suppressor gene p53: „One way to understand the p53 network is to compare it to the Internet. The cell, like the Internet, appears to be a ‚scale-free network': a small subset of proteins are highly connected (linked) and control the activity of a large number of other proteins, whereas most proteins interact with only a few others. The proteins in this network serve as the 'nodes', and the most highly connected nodes are 'hubs'." (Vogelstein et al.: 2000, quoted in Keller 2005, p. 1060) This model is now international standard in proteomics (see e.g. Stelzl/Wanker: 2006). The *scale-free-network*-approach combines imitation, automation and simulation, and nevertheless allows the future outcome of the living process to be imagined as "open" in a mathematical sense. *Potentiality* is substituted by *possibility*. The network is not a fixed architecture, but is regarded as generative. Life in proteomics is modelled as „interactome". However, how about growth?

The comparison with the so-called *wet ware*, i.e. the biological system in which the interactome actually functions as such, remains necessary to prove the modelled functions. That means you have to fuse structures and then *plant them in synthetic cultural media*, in order to see what will grow from it. In proteomics this is often done by yeast two-hybrid-experiments. Only growth gives evidence for reality and proves the stated hypothesis about the interaction of proteins and, moreover, generates new hypotheses. By growth one can find out, which protein interactions (modelled *in silico*) obviously never occur *in vivo*. The bioinformatical approach using network simulation for designing biofacts exceeds the limits of the time-consuming methods of biochemists and geneticists. (Two Dutch Genetic Engineers stated in 1999: "In the well-known analogy to understanding how car runs, biochemists disassemble the engine, transmission and body, characterize all the pieces and attempt to rebuild a working vehicle. Geneticists, by contrast, break single components, turn the key and try to determine what effect the single missing part has on the car's operation." (van Criekinge/Beyaert: 1999, p. 2) Proteomics go far beyond that, they need to work in silico.

In order to prove the assumed functions of localized genes by the activity of characterized proteins, several *fusions* (some of them, e.g. mating assays, carried out by laboratory robots) have to take place. This is also true for styling model organisms towards *prototypes* for industrial production ('bio-commerce'). Fused objects still end up, methodological 'old-fashioned', in being planted into culture media, giving them the ability to grow. These plantation techniques nevertheless imply the presence of nature as it is and show that the analogy of 'implementation' and 'implantation' is a false friend.

6. Biofacticity and Hybridity

Let me conclude with some remarks on the connection between anthropology and philosophy of technology. If we take the anthropological fact into account, that humans are hybrids (as put forward by Bruno Latour: 2002), having both a natural and a technical essence, it makes them designers with an individual "Leib" (a German-derived term in phenomenology for the subjectivity of one's own corporeality). The have a subjective feeling of themselves, an own body only they perceive. We can ask: In how far does biofacticity, as an epistemological concept, undermines hybridity as an anthropological concept? In other words: where is the epistemic border for biotechnology to model "life" – and where does the legitimation come to, first, *constitute* and to, second, *respect* this border?
There is no easy answer to these questions. In Bruno Latour's book *Politics of Nature* we read: „What is a subject, actually? That which resists naturalization. What is an object? That which resists subjectivation.“ (Latour 2004: p. 47) Maybe this is a bit too easy for the challenging research in the Life Sciences, and maybe this is due to the use of actor-network-theory (ANT), where the question of beginning and end of networks, nowadays a dominant metaphor, is avoided. In Western ontologies, "life" begins with plant life. But life sciences work with cells, not with beings. Nevertheless, both are continuants. In this perspective a border to "the human" does not exist and the ontological categories made up by Aristotle become fluid. Cells to be designed can belong not only to either plants, animals *or* humans, but always theoretical include the application on humans. Methods like cloning and transplantation are derived from plant science and found their way into biomedicine. In Biotechnology, working exclusively either on microbes, plants or animals is gone. - With plants humans share more than 50% of the genetic structure, stressing phylogenetic growth as a continuous evolutionary process of gaining higher complexity.

How to break free of this conclusion, that the ontologies from the life world are not fully resembled by the living objects in the laboratory any more? Martin Heidegger emphasized that the Greek term *arché* implied not only a first beginning of something to be, but also a sphere of own *dominance* over this one being, respectively being one (Heidegger: 1967; Karafyllis: 2006a and b). The hybrid character of the human being as a growing entity and creative person who acts in light of self-determined ends, allows us to take the fact seriously that human beings exist both within the spheres of nature and technology, science worlds and life worlds. Thus I am voting for a broad approach towards the idea of life, which allows for an understanding of personal growth in experience without reducing life to biological processes or functions of the genetic code. The ancient idea of soul is still needed. If you doubt that science will take its impact serious, you can currently watch a religious shift in Western Societies. It is not only but also centering on natural ontologies and creationism, accompanied by a vast increase in the publications on Science and Religion.

In my talk, I wanted to stress that even if growth can be modelled with technical metaphors, models and apparatus in order to reach a uniform standard of certain growth *types*, the growth *token* in order to make it real still belongs to an uncontrollable sphere of nature. Nature will not vanish, as it is often argued, but *technology* will be disguised. You do not see anymore what is a technical and a natural thing. What living entities actually *can* 'do' is found out by provoking them 'to do' something (e.g. to fuse or to produce a certain amino acid). The potentiality of the term 'can' remains an ontological problem in the sphere of metaphysics.

7. Cultural Philosophy of Technology

Finally: Why do engineers and scientists need a cultural philosophy? The term "culture" refers to the fact that a society communicates *symbolically* (Ernst Cassirer, Clifford Geertz, Pierre Bourdieu). The use of symbols is regarded as a special human ability, which only some of the big apes are also capable of. Symbols always have a history and likewise this is true for plants. Thus, living beings cannot only be regarded as material, but as images and narratives of the past, which have something to say for the identity of a specific culture.

To give you another famous example, which fits the calendar (as it was Easter time last week): in Europe it is now discussed to use bioenergy, i.e. plant biomass for combustion. As the European agriculture highly depends on crops like wheat and maize, the engineers have planned a special technology for making heat out of wheat. But the public acceptance still is rare. First, the wheat stands for bread, and reminds the soil-rich Europeans of the fact that in many countries of the world people are starving from hunger. Thus, it is seen as unethical to burn it. On the contrary, it is said that climate change will most of all affect the developing countries, and so it is our moral obligation to use fuels which are neutral in CO_2. The photosynthesizing plants are, somehow, carbon-neutral. But second, the wheat in Christianity-based cultures stands for the body of Jesus. It is eaten during the church service, when the attenders at church take part at the Lord's supper. As such, it is a symbol of forgiveness and resurrection. So wheat has a certain value for life not only in the material but also in the symbolic sense. Depending on that value, a norm is developed: Do *not* burn wheat for heat! But find more intelligent solutions.

'Culture' is derived from the Latin '*colere*' and means the planting and harvesting acts in *doing* agriculture. Quite similar at first sight, the laboratory in the Life Sciences is an epistemic unit, where growth and action, nature and technology, objects and subjects are included. So maybe it is time not only to see society as a laboratory, but also to see the laboratory as a room, where agricultural practices found their way into – starting from monastery gardens, botanical gardens and orangeries.

This crossing between growth in life worlds and laboratories is wonderfully illustrated by a BioArt Installation. The Arts took challenge of the new biotechnologies. The project is called "Lawn Chair", from the NewYork BioArtist Julia Reodica (shown in New York 2002, at CHLOROPHILIA). Invasive weed grass in the living room is serving designed artifacts – and a human being who feels at home in her own laboratory.

So biofacts influence hybridity. We model our life world like a laboratory. Where will this end?

If the outside world of the living becomes all technological, how does our inside world of being change? Are we becoming robots, like some transhumanists envision? At least we should think about, if we really *want* to become robots. **When nature is gone, the human person will not be a designer any more, but he and she will be designed.**

This photo reminds us that biotechnology also has an important impact on gender issues as the reproductive capacities and materials belong to the female sphere to a vast extent. So if the agricultural practices of using "mother nature" is brought into the laboratory, that means women will have to donate reproductive material, like egg cells e.g. for cloning techniques. For an ethical evaluation of technology, this reminder has to be taken serious.

Let me conclude with a last remark. Cultures depend on exchange. For the anthropologists, Ethiopia is the cradle of life, and thus the cradle of culture. "Lucy" (Australopithecus afarensis) came into being here. She was the first human being known. - Please let us Europeans also learn something of your long-lasting, productive life, and how to sustain a high culture.

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