Text 11

Discuss the problems mentioned in the text.

Assembly Line Robots & Swarm-Intelligence

Looking at the production system we see that the dominant idea, even if we are in actual fact already working within a network is still one of a sequence or a line: the assembly line. If we look at late modern production systems we see, however, that it is not organized according to the tradition of the assembly line anymore, but rather according to an integrated network of different assembly lines (and the same applies to the traditional idea of supply chains) (Zimmerli, Bagusat & Muller 2007). But the main idea is nevertheless still that of an assembly line of robots, the type of robots e.g. you usually see at the car production. They do not show "android" features, they do not look homo erectus-like, but you see e.g. one great arm. And this great arm performs almost the same movements all the time. That is what assembly line robots are all about. They seem to move on their own free will. One looks at them and they seem to display intelligent autonomous behavior. And one would not even be capable to tell whether they are actually internally programmed to do that or whether they are developing their program as they go along. It would not be possible to tell that because there is an asymmetry between the possibility to explain these movements after the fact and the possibility to predict them before, i.e. an asymmetry between explanation and prediction. These assembly line robots seem to move on their own free will. Under certain circumstances and under different conditions of carrying out various operations, they may seem (to some observers) like independent beings, who program their own set values.

What we have seen before applies here too: if the only action which these robots cannot do, the only limits to robots taking over work operations in the production process would be the setting of the values by themselves, then of course everything else, every operation that can be described by software production analysis methods can be carried out by every suitably implemented machine.

The only thing that cannot be carried out by suitably implemented machines is the setting of the set values itself. And if we apply the notion of "network," then it becomes obvious that the operation of networks of robots can easily be programmed, be it by human beings or by machines: Of course we can design machines, which are capable of designing networks of programs of machines.

Originally swarm intelligence used to be a notion taken from the biological sphere, especially with respect to the behavior of ants, birds and fish. But these days we speak about swarm-intelligence of robots, especially of nano-robots, which are very tiny little devices displaying intelligent behavior themselves (Winfield, Harper & Nembrini 2005). Or to put it more precisely: the behavior displayed by swarms of small robots ("nanobots") is not a behavior called "intelligent," because the individual nanobots display intelligent behavior, but only because the system of intelligent nanobots is displaying intelligent behavior. That is why the very notion of "robots programmed in an assembly line (or any other kind of collaborative pattern)" is presupposing the idea of a decentralized *meta-program* or rather a behavioral collaborative pattern of robots (or other "intelligent" machines) – and this idea is what we call "swarm-intelligence."

So the question is not whether the individual robot in an assembly line performs intelligent behavior (that is always the case, because that is what they are supposed to do) but the assembly line itself has to display intelligent behavior.

Example: given that a robot as the individual intelligent production machine always takes a piece or device and puts it over here and does all the time with it, what it is programmed to do, and given that there is no piece or device around then the whole system does not work. So the individual robot could perform the same operation as many times as it is programmed, but if the supply of the elements needed to perform an actual labor action by doing this would be lacking, i.e. if the system would not be so efficient by not having a sufficient supply of elements or devices, then the system itself would not be behaving in an intelligent way; it would run empty.

So, if the network itself is not programmed intelligently then there is no way of talking about intelligent behavior of robots. Therefore, we have to deal from now on with what I call meta-programs or meta-robots. The discourse on robots has in actual fact already been replaced by the discourse on meta-robots, if we talk about robots in this new system-oriented way. With regard to this meta-robot, however, an asymmetry-hypothesis (that seems to be valid) between observation of behavior and programming is applied.

Although we can observe intelligent behavior it is possible that we cannot program it. What we find here is the next level of the asymmetry between explanation and prediction in the philosophy of science and it is called the difference between programming and teaching. The very notion of "teaching" is used here in a system, which does not deal with the interaction between teachers and students at all, but with the interaction between human beings and machines. For instance, if one tries to program a laser welding device then one does not have to write programs anymore.

Consequently, what we do is teaching the machine by actually physically guiding it, by taking the laser welding arm and putting it into some place and then putting it over and bringing it back, and then putting it back over there. And after doing that a few times the machine has "learned" it, and from then on it does it by itself. Of course, it does not literally do it by itself; it is not autonomous in the very strict philosophical sense of "autonomy." But we have taught the machine to do that and the machine does it, unless we teach it to behave differently.

We can teach the machine by talking to it, in written language (program) or by showing it how to behave, by taking the laser welding arm again and putting it to a different place etc. By doing so a few times, you have taught the machine to behave like an intelligent being. And pretty much the same applies to swarm intelligence of a system which has to be "taught" and not just programmed.

(by Walther Ch. Zimmerli)

Text 12

Study the text. Be ready to speak about its main ideas.

Robotics as a Future Vision for Hypermodern Technologies

The robots of today are smart, but they are not smart enough. They have to act under pressure: Their employers always require higher and more complex performance.

There is especially one thing of what they have to be capable of: thinking. The almost unstoppable triumphal procession of the working machine ended up in stagnation during the past years. Even despite remarkable technical improvements, most of such systems are still comparatively dumb. For example, Car-O-bot can easily open a room door. But once the door is stocked, because the frame has got distorted, the machine becomes helpless. The same thing happens to a welding robot once the assembly line stops. Robots are not yet useful for practice. Robotics-research was focused far too long on the necessities of only a few industries. At that time people did not invest into the intelligence of robots, but into optimizing the environment. Now there are robots, built especially in order to be integrated into small and middle production processes. This new generation of robots is at least limitedly able to cooperate directly with human colleagues. But to enable such an improvement, the machines are required to perceive their environment, e.g. tools or instruments. One of the most important tasks is the precise proportioning of power. The dialogue between human being and a machine is hard working as well. But things that work in sterile and clean laboratories do not have to work on the outdoors. More and more objects and characteristics need to be included by the machine if its environment gets more and more complex. Increasing speed and stability are lowering precision and controllability. This is a cultural breakdown for the engineers, who usually try to control everything with precision.

The terms of “technique” and “technology” are used quite similar. Relating to my phenomenological-hermeneutical method, the following distinction is recommended: Technique refers to technical abilities and the produced artifacts as well as their use. Technology describes the technical knowledge and the teaching of technical knowledge (about technical courses of action and about operational sequences), and further the out coming machines and technological structures. Both kinds are interacting with each other and exist nowadays next to each other. I will call the sum of techniques and technologies the “technical world.” An adequate definition of the technique, which I, for further valuation, take as a basis even for the interaction of humans and machines, demonstrated in the description of the production cycle. It has got three aspects with two sides in each case: It includes (1) the construction and the production of instruments and works, as well as the use of instruments, (2) the use and the consumption of technical works and (3) the disposal and the recycling of technical works and of new products in terms of a closure of the circuitry. The two aspects are (1) producing and using in terms of human actions and (2) technical instruments in order to perceive works as describable physical, chemical and biological operations. The Production of something is a technical action in a proper sense, to use something refers to determined technical handling and to dispose of something refers to technical handling in a classical meaning. The subject of

Philosophy of Technology is technical and technical determined handling, since technical handling is performed to finally enable technical determined handling.

The subject of Philosophy of Technology is in the strict sense the mutual relation of technical handling and technical determined handling. Different technical potentials have to be seen as a result of the connection between technical handling on the one hand and technical determined handling on the other hand. The cycle of technical and technical determined handling, as different kinds of “know how,” implies a dynamization of the concept of technical handling and a transformation of the different kinds of technical practice. The classical concept of *poiesis* and the *instrumental rationality* are no longer appropriate to the current technical reality.

The human handling of a technical artifact puts it into an anthropological context, into an anthropological potential. The human being is in possession of a handling knowledge, an implicit know how of the effect, which can be achieved by technical handling. This implicit knowledge occurs as individual knowledge within individuals, even in animals (e.g. the gull and the clam), but it does not occur as a systematic world knowledge. The world knowledge is the collected handling knowledge within the world including the own finiteness. The capability of human handling is related to the world, full of theories and sense.

(by Walther Ch. Zimmerli)

Text 13

Read the text and then comment.

The Different Cultural Robot-Traditions in Europe and Japan

The concept of the robot (as automat) belongs to the mechanical tradition of engineers, researchers (example: “Frankenstein”) and of the working machine in Europe. The mechanism conceived as something unnatural, with the result that the mechanical automata had often developed a terrible independent existence.

Automata are working machines in Europe. They replace labour although it is high valued social good in Europe. Changes of our environment by autonomous intelligent technology (automation) could be larger than changes, which are triggered by the humanoid robot which is conceived as a human companion and partner. From a European point of view the more important issues are found in the automation and in the change of the paradigm of work. The robot in Japan, especially the humanoid robot, emerged from the tradition, from folk culture and from pre-scientific myths. As a matter of fact he has not such terrible independent existence like in Europe and is derived from a childlike scheme. Humanoid robots are therefore more popular and socially acceptable in Japan.

During the ancient times they were suggested to be freely deployable and controllable slaves called “androids.” Hephaistos has forged Pandora through godly mission. Even Daidalos, artificial created human beings (in the sense of living statues) became traditional since the Greeks. The “Iron Maiden” of the tyrant Nabis of Sparta (200 B.C.) was even a real statue. Citizens who did not pay tribute got “hugged” and then speared by her stings if they would not pay on time. During medieval times there have been threatening and inflective statues. The mechanical clock and automatic mechanisms were discovered first at Byzantium and Arabia. The "Iron Man" by Albertus Magnus did appear to serve as his doorkeeper.

The 18th century has been the century of "androids," which occurred within various legends during the age of the mechanics (Volker 1994). The flutist was a system of bellows, driven by clock units. Pygmalion can be seen as a living statue (Volker 1994). Within the Greek mythology the forging goddess Hephaistos was responsible for creating artificial beings. Daidalos, the Attic master-builder, belongs to the fabulous mankind creators, as well. His inventions are already technically comprehensible. The term "android" relates to the Greek words "aner" ("man," "human being") and "eidos" ("look," "form," "shape") what stands for "The human copy." Admittedly, he was shaped first during the time of absolutism. During the 17th- and 18th-century the artistic clockmakers promoted the replication of the human being to new heights. But within the Industrial Revolution, the practical interests to create human like machines got lost for the engineers. Mary Shelley's literary character of "Frankenstein" is a counter movement to this. Shelley quotes a basic topic from the literary illustration of technology: the unpredictability of research and invention with cross natural borders (Drux 2001). These discussions are nowadays promoted, facing artificial life and expert systems. Especially the defeat of Kasparow in his match with the computer deep blue has caused a sensation. The computer's game appeared to be intuitively right, inventive and highly intelligent to Kasparow. What a human would have done for his feelings had been calculated through a machine. The world champion concludes that high quantity leads to quality at certain, at least in chess.

E.T.A. Hoffmann talks about "androids," what means humanlike beings. An artificial human being plays for example the main character in his work "Die Automate" from 1814. The "speaking Turk" is the protagonist, an automat, which is so artistically manufactured that it is impossible to find the source of its voices. The speaking Turk is adequately responding to questions by ingenious and appropriate answers in different languages. Automata are imitations of human beings, which are almost perfect if they are no longer to distinguish from the original. A certain kind of averseness towards the waxworks becomes apparent in the writings of E.T.A. Hoffmann, even if the instruments of the artists are very reasonable. The automaton and the mechanical orchestra of the professor are displaying the dead and numbness of the machines music. The mechanic is using his ability (art) for this adverse joy and not for the perfection of musical instruments even though the perfection of the musical instruments would lead to higher musical mechanisms. Natural noises and environmental music are put into one context. Hoffmann's conclusion is that the human being is not replaceable via technology. The automaton is not the right execution of technology. Hoffmann plays with the ancient and romantic motive: technology is limited. Technology should be used to build musical instruments, and therefore it is decreed as pure device. Technology has to be used and controlled by the human being. But the human being should not be replaced by technology. In E.T.A. Hoffmann's "Der Sandmann" is an "android" as well, same as in Ambroce Bierce's "Moxon's Master" and as in "Meister Zacharias" from "Le Docteur Ox" by Jule Vernes.

Robots, cyborgs and other "androids" are playing a special role in the science-fiction literature of the past decades. During the era of Reagan emerged a movement of massive anti-technological sentiment. It was caused by the Vietnam War, which just reverted into renewed optimism, while new technologies promised an economical strengthening (upturn). Models have been formulated in Star Wars where the scheme of a robot was transferred into a defence system. This led to a proceeding militarization of the universe. A cyborg contained subjectivity in the "theatre of mind." The movie "The Terminator" has been characteristic for that. Cyberspace is an artificial world within one computer or within a network of computers. It is the matter of an artificial intelligence without human corpus or body. The cyborg represents the abstraction and emotional distance, which is produced by technological media. Computers are also central in the movies "2001 – A Space Odyssey" and "War Games" from 1983. Machines can be obsessed, they can be constructed as servants and act like servants. But there is a counter-movement which assumes subjectivity for machines. In this way the cyborg can get rehabilitated. Such "android" commanders are for example displayed in the movie "Blade Runner," which is about "replicants."

(*by Bernhard Irrgang*)

Text 14

Read the text about a computer algebra system and outline its main ideas.

Computer algebra system

A computer algebra system (CAS) is any mathematical software with the ability to manipulate mathematical expressions in a way similar to the traditional manual computations of mathematicians and scientists. The development of the computer algebra systems in the second half of the 20th century is part of the discipline of "computer algebra" or "symbolic computation", which has spurred work in algorithms over mathematical objects such as polynomials.

Computer algebra systems may be divided into two classes: specialized and general-purpose. The specialized ones are devoted to a specific part of mathematics, such as number theory, group theory, or teaching of elementary mathematics.

General-purpose computer algebra systems aim to be useful to a user working in any scientific field that requires manipulation of mathematical expressions. To be useful, a general-purpose computer algebra system must include various features such as:

- a user interface allowing a user to enter and display mathematical formulas, typically from a keyboard, menu selections, mouse or stylus.
- a programming language and an interpreter (the result of a computation commonly has an unpredictable form and an unpredictable size; therefore user intervention is frequently needed),
- a simplifier, which is a rewrite system for simplifying mathematics formulas,
- a memory manager, including a garbage collector, needed by the huge size of the intermediate data, which may appear during a computation,
- an arbitrary-precision arithmetic, needed by the huge size of the integers that may occur,