Protocol of panel discussion

Erik: "I would like to address my first question to Mr. Bölker because he is an active researcher: How do you perceive news in Synthetic Biology? Or is there no report at all? How do people react when you tell them that you are a professor for Synthetic Biology?"

Bölker: "To begin with the last question, I am not a professor for Synthetic Biology. I think there are not many people in Germany who are that yet. Probably there are of them soon. Sometimes people ask me how to become a synthetic biologist. I have the feeling that you can only become a synthetic biologist when you are young. Nevertheless I put my attention on that topic. […]
Indeed the protagonists of Synthetic Biology are very good in selling their affairs with methods whereby the hair of some scientist's stand on end. To name examples: Letting trees grow so big so that you can live in there or the green cows on the field, Karberg told us in his talk. […]

Of course reports support the general knowledge of Synthetic Biology, but conceptionally it does not work at all. Only the people who want to inform themselves get in contact with these reports. The actual question is: what happens to Synthetic Biology in the future? Maybe the same as to Nanotechnology – suddenly appeared and as fast as it had appeared it was disappeared."

Erik: "Summarizing, there is little information, but if there is then positive and pro Synthetic Biology. According to our survey on the issue the Internet holds up to its reputation as the most used information source. Since we have a journalist as our guest, we are interested in his opinion. Is the internet as the main source of information a curse or a blessing? Mr. Karberg, do you think the Internet is really an appropriate source? What do you think about wrong information or too much information from the internet? Or should a well-researched report be favored?

Karberg: Of course a report should attract more interest. I think the reason for the survey result is that especially young people use the Internet as their main source for science, because it seems that they can have a more active research as compared to a newspaper. Nevertheless, without assessing the question, […] I believe that the attention is still aroused by mass media. Here, provocative headlines are used like "We are God" or anything of that kind. To complete this, such headlines are by the way on the first position in discussions about scientific reports. […] In my opinion an article is good if it has not those provocative headlines. Such articles can also be found in the internet but a long and intensive research is prerequisite."

Erik: "So you said that a report serves as an introduction to the topic but you should choose those without a provocative title. For better investigations the internet could be useful was well."

Mrs. Deplazes-Zemp you are working on the information platform "SYBELL" with the aim to inform the society about the topic of Synthetic Biology. Of course we want to know if this platform works and who visits your webpage – rather scientists or citizens without any scientific knowledge?"

Deplazes-Zemp: "Public engagement – that is how such platforms use to work. It is really difficult to say who reads the webpage at all. Nowadays the problem is that there is an overkill of information. […] For me it seems that the society does not care about Synthetic Biology. It is nothing that concerns the population. I do not know if it is helpful to give them more information than they want. […] Nevertheless quite a few people have even heard about Synthetic Biology."

Erik: "Thank you very much. You just mentioned that Synthetic Biology suffers from not being completely recognized by the society. Therefore we used other words of genetic engineering in our survey. Now Niko will present some results. […]

Erik: We are happy to have someone here whose company works with biotechnology and genetic engineering. We are interested in how far your company makes use of it and if Synthetic Biology is a keyword in your company at all? Concerning the topic of information, we are interested in how can the consumer get information about your products?"

Strittmatter: "I will begin with the last question. Which consumer do you mean?"

Erik: "Well, the consumer who eats the products."

Strittmatter: "There is exactly the problem! These are not our customer. Our customers are the farmers. Maybe here are some farmers present? Our customer, the farmer, gets an intensive support using different types of media. Of course we also use the Internet. We have a department for direct customer support including a task force that is specialized for specific regions. There is a very intensive information flow. The consumers, as we are, are not in direct contact with our products like seeds for maize, sugar beet, rapeseed etc.. Instead the consumer is in direct contact with the products the farmer or food industry produces out of our seeds. Thus, there is no direct contact to the end-consumer.

The second question was, if the company is familiar with the keyword Synthetic Biology. Concerning to this I can say: yes we are familiar with Synthetic Biology. Where do we get this news from? Of course we are interested in the evolution of science of different disciplines that are relevant for our company. Interesting disciplines reach from breeding to plant breeding of agricultural faculties and of course to Biology, Chemistry and Microbiology. That is why we are interested in Synthetic Biology. It is the curiosity, the interest in monitoring such developments as well as the social discussions about the topic. We do not have any reticence according to critical topics. In the past 20 years KWS has observed and was active in the discussion of genetic engineering. There we have made experiences with defeats and success. To sum up, we have experiences with this topic. The third point is that we are interested in new methods of science to improve our plant breeding methods. That is because we

are willing to learn. The last question concerning where we perform this, the answer is in genetic engineering."

Erik: "So you describe Synthetic Biology as the coronation of genetic engineering?"

Strittmatter: "Of course Genetic engineering plays an important role. But unfortunately we have to differentiate on the geographical basis. Our scientific laborites are located in Einbeck and its neighborhood. We are working in this field for more than 20 years now. The products we mostly sold are herbicide tolerant sugar beets in North America. And now you know why I said we have to differentiate this on a geografical basis. Genetic engineering plays an important role in North America, South America and its importance increases in Asia. That are the markets we are interested in, but the development and optimization of products as well as the research we are performing in Germany. But here in Germany it is not possible to perform a field study because opponents of genetic engineering would destroy the fields. In North America the market increases and if you want to hear some numbers, we investigate 20% of our research- and development money into these fields what makes 120 – 130 million Euros."

Erik: "Thank you very much for the information. If you are wondering why we are not directly discussing the questions about risks – we will come later to that topic. The discussion about chances and risks is a big topic that we became familiar with when we performed the survey. But now I want to ask Mrs. Deplazes-Zemp who is responsible for ensuring transparency of topics like these, without paying attention on if it is a risk or not at the moment. Who has the job to inform the people? Is it the producer who should label the packaging according to a EU-project? Or where should citizens take their information from? Who do you think is responsible?"

Deplazes-Zemp: "In my opinion it should be a cooperation of all participants."

Erik: "The survey showed us that the majority was not informed about still having used genetic engineered products. We want to know where the reasons are and who is responsible to spread information around?"

Deplazes-Zemp: "So the question is, do we have to know that?! We still do not know many things. It is not possible to know everything at all. And do the people really want to know that? […] In the case the people do not demand that, it is not necessary to inform them."

Niko presents some survey results.

Erik: "The next question goes to Mr. Karberg. As Mrs. Deplazes-Zemp just said, if a citizen likes to have some information, he should get some. However, he might not yet be familiar with the dangers- Where do you think a labeling could make sense? Or will the products then become a certificate jungle? Where do we have to pay attention? For which products could it be acceptable that they are not labeled?"

Karberg: "The society should be aware of which products they want to be labeled. In my opinion a labeling only makes sense if a product has known risks. I am sure that people would reject labeled products, because they are not able to estimate possible risks. A label does not express if the product is produced in a genetic engineered procedure or if it was only in contact with genetic engineering. After all there are so many different genetic engineering methods. For instance you could say that some seeds that were produced this way but in the end there is not any genetic engineered material included. Some breeding steps are tested using genetic engineering in order to check if the expected outcome is achieved. Genetic engineering is simply faster. By performing conventionally breeding techniques the end products are free from genetic engineered compounds and therefore can be sold on the market. Another question is what happens if small amounts of (bacterial) DNA and its products are found in bread. What could be possible risks of these small amounts? I do not know how much, but we eat many of DNA every day and it is completely harmless. The main question should be what are the real risks? In my opinion

the labeling that currently exists is too general. But that are the nowadays regularities. I think the labeling arose out of unfounded fears."

Deplazes-Zemp: "I agree with you. But I would say if the society wants some information there are reasons. […]"

Karberg: "Basically, this argumentation, which is absolutely ok, would also involve the labeling 'synthesized with pesticides'. In that case this label would have to be printed on all affected groceries. In my opinion pesticides are even more dangerous than those based on genetic engineering. Hence an example is made; only because genetic engineering is – perhaps also due to me – in the media it is currently picked out to provide risks. There are many other techniques that could be treated similarly. I am not totally against labeling, but if there is a labeling for genetic engineered products I am wondering why there is not a labeling for pesticides."

Strittmatter: "I would like to give a short statement. The consumer has the decision to claim for a labeling. Labeling would show which products consist of genetic engineered material – this would be an interesting experiment."

Erik: "We will mention that in the letter we want to send to the Federal Ministry of Education and Research. To come back to the risks, we provided an excerpt of the Bioethical forum of the German ethic council:

> Prof. Dr. Bärbel Friedrich (HU Berlin) at the bioethical forum of the German ethic council 24.02.2010

…there is no necessity to create a new legal regularity specifically for Synthetic Biology. The risks are covered by the law on genetic engineering. Nevertheless it is possible to install security and control mechanisms in organisms to prevent spreading in nature. This would also reduce the risk that known causative organisms could be synthetically reconstructed and modified. But the dubious thing is that **databases of pathogens and toxins are freely accessible** and BioBricks can be ordered in the internet – here precautions are necessary. (German ethic council: annual report 2010, S. 33ff.)

Mr. Bölker do you support this statement or what do you think about it? Is it really possible that everyone has the opportunity to order toxic genes to create a toxic *E. coli*? Or are there any control steps in the ordering process which prevent me from ordering such genes? I am asking that because it is not possible for me to order explosive material either, right?"

Bölker: "I have not tried it yet! I think there exists a BioBrick category labeled with a skull, the so-called 'cell death'. Indeed those are toxins, which can be ordered in the part registry. But you have to remind yourself that these are toxins for bacteria. An innate phenomenon is that for example the stability of plasmids or those extra-circular elements stabilize themselves by synthesizing a toxin and an anti-toxin. In the case of a loss of DNA, the toxin is always more stable than the anti-toxin, which lets the cells kill themselves. This guarantees that only those cells, which pass the plasmid on to the offspring, are able to survive. […]
The other thing is - we have experienced it - a discussion of bioweapons. This is deposited in the safety category. Especially in North America this is a big debate. There, the fungus *Ustilago maydis*, the organisms I am working with, is on the top list of fungal pathogens, because its host pathogen is maize. Theoretically it is a relatively harmless organism, but it infests maize. For this is a great economic factor in the USA the pathogenicity of the fungus is strongly dramatized. Indeed, it is the case that genetic engineering research would be much more difficult to control than the commerce with nuclear material. […] Yes, the supervision is a big problem. And this is well known.
Two possibilities are thinkable: governmental regularities or the companies that produce such DNA have to control their customers on their own. The companies decided to perform an automatic check, meaning that they control all received orders. […]"

Erik: "Some minutes ago we were talking about the acceptance of genetic engineered products. Let us have a look at the survey results."

Niko presents the results.

Erik: "Now we want to know from Mr. Strittmatter why his sector (genetic engineered plants) comes out badly at this question although the consumption of such DNA is not dangerous like Mr. Karberg told us before."

Strittmatter: "[…] Nobody has to starve in Europe but if we are ill, medicals play an important role."

Erik: "Let us come to the topic risks and advantages. Mrs. Deplazes-Zemp you are an expert in this field. How would a consumer make cost-benefit analysis and how would you explain the result of this survey question?"

Deplazes-Zemp: "I am not really sure if it is a cost-benefit analysis. […] National projects on the subject revealed that there are no risks. Nonetheless many people put the risks into spotlight."

Erik: "Apropos opponents and risks, Mr. Karberg what are arguments and risks we should really care about? Eventually you could explain the difference between DNA uptake and pesticides."

Karberg: "I am not a toxicologist or expert for chemicals, but I think the consumption of chemicals like pesticides of every kind and concentration can be dangerous. Without doubt there are risks in Synthetic Biology because it is not yet known which organisms are created and which biological properties they will have. This has to be tested. Genetic engineered plants are not tested without any reason. Here scientists want to have a carful dealing. For when I combine two properties, which is possible by introducing genes from other organisms into a plant, which never ever had seen these genes before, things can happen that had not been imagined before. I am remembering an example from Australia. They worked with a virus and created a mixed-virus out of two different viruses. The result was that the tested mice dropped dead, which surprised the scientists as well. Things like this can happen and maybe on a larger scale whereby not only small genes are combined but whole genomes. The consequences are not foreseeable. […] Of course that are risks we must keep in mind. The whole questions are very theoretic because until now has nothing happened. But we have to remember that since the beginning of

recombinant genetic investigation researcher of genetics came together to discuss possible risks. […] These scientists have developed security systems. One of the famous *E.coli* strains developed by them and with which the iGEM teams are working with, by the way, is *E.coli* K12. This strain has some mutations that make them unable to live outside the laboratory. Precautions like these are very important nowadays. There was no 'MCA'!"

Bölker: "[…] The problem with genetic engineered crops is that the consumer has no need for it. Nobody is saying: 'These apples do not taste – we need genetic engineered apples.' There have been genetic engineered tomatoes but they did not taste good. […]."

Erik: "Nevertheless we asked the people what they think about risks."

Niko presents the results.

Erik: "Another topic often discussed in this context is the environment. People are concerned about genetic engineered crops like maize and soybean growing on fields. Mr. Strittmatter can you confirm the fears or calm them down? What is KWS doing to reduce such risks or to prevent such negative influences to the environment at all?"

Strittmatter: "First I have to say that we only sell products that passed through all genetic tests which include the evaluation of risks and then has been evaluated as good. Such tests take a long time, let us say about 5 to 10 years. I can tell you something at this point. KWS performs a case-to-case consideration. We do not put all that is possible into practice. A risk and use evaluation exists. The decision is made by the market, which includes the consumer. For this there exists a regulatory framework, which is of course followed."

Erik: "Do there additionally mechanisms exist that reduce risks? Is there a protective mechanism?"

Strittmatter: "To answer your first question: Maize would not have a copulatory partner in Europe. It would not work even if there existed a

protective mechanism because the consumer just does not want genetic engineered crops!"

Erik: "I have prepared one last question for everyone regarding to the future. Mr. Bölker, what do you think what are possible achievements Synthetic Biology could present in the following years? Are similar milestones like the decoding of the genome possible?"

Bölker: "The problem is, nobody is able to predict the really new things. If I would already know it, it would not be anything new! […] I can imagine that Synthetic Biology will present some interesting projects in the future, but nothing like flying fishes, rather in the area of microbiology. Great projects that are already produced are the synthetic production of citric acid by *Aspergillus niger.* There are not enough lemons available on earth to produce as much as citric acid as consumed. I have some doubts that new projects are based on minimal organisms. I think synthetic biologist will learn this from true biologists. A minimal organism functions under very specific conditions. […] I heard synthetic biologists say: 'the real life is too complicated for us.'"

Erik: "Mr. Karberg what are your wishes concerning the information outtake of Synthetic Biology for example in school?"

Karberg: "I think that they talk much about molecular biology. My son is in the 6th grade and he learned about photosynthesis including molecular formulas. In my opinion that is a little too early! I would be happy if the basics of biology, for example: 'which kind of tree is it in my garden?' would get more attention. Basic biology needs much more additional requirements. Then the impression of biology would not only be the one that everything functions by machine. […]
I will make an appeal to all journalists: please orient on facts, ask your questions to politicians and observe possible society risks regarding to new technologies. […]"

Erik: "What are ethic challenges? Do we need a Hippocratic oath in biology – like that in medicine? Where are the limits?"

Deplazes-Zemp: "The main challenge is not to force the discussion. […]"

Erik: “Mr. Strittmatter my last question is where do you think is the position of Germany concerning the economic needs? Do you have wishes to the legislature although the consumer controls the market?”

Strittmatter: “We do not need more laws. It is not all about the number of laws but on the consequence. Only if the law of genetic engineering comes into force we could make field trials. I wish that the direction does not change every four years because research and product development takes some time and costs much money – 5 millions per 10 years. […] I wish that scientific research really shows what it is doing. Think about risks but do not think about application every time. I would prefer an open-minded research-sphere at universities and companies. […]”

Question from the audience: “Would you eat genetic engineered pasta?”

All: “Yes! […]”

Karberg: “But I would have doubts because these pasta would for sure be connected with a big company.”