# When something useful becomes menacing - a debate on «dual use» research

**At the last annual conference of Life Sciences Switzerland ($LS^2$), which was held at the University of Zurich on February 2 and 3, 2017, the Forum of Genetic Research organized a panel discussion on the topic of "Misuse potential in biological research". Young scientists discussed about their understanding of ethical research, the importance of open communication and the unpredictability of biological research. With this event, the Forum for Genetic Research adds to its activities on the topic of "biosecurity" consisting of a series of workshops and a publication.**

Originally, the term "dual use" comes from export control: dual-use goods are products that can be used both for civilian and military purposes. Anyone wishing to import or export such goods to or from Switzerland must report this to the customs authorities and require an authorization in accordance with the laws on the control of dual use goods or war materials. Not least as a result of the terrorist attacks in the past decades, however, the usage of the term has broadened. Today, "dual use" refers to products but also research results and publications, which were developed with good intentions, but could also be misused for malevolent purposes.

**On dealing with double-edged research results: input talk by C. Invernizzi**
The recent breakthroughs in genome editing and gene synthesis have reinforced the concern about the possible misuse of biological research. As Cédric Invernizzi, Head of Arms Control and Research Coordination at the Spiez Laboratory, explained in his input talk, the US intelligence agencies had recently classified the CRISPR/Cas9 method as a potential agent of mass destruction. This is because targeted interventions in the genetic make-up of organisms could in principle also be carried out for malevolent purposes, in order to harm humans, animals, plants and the environment. C. Invernizzi illustrated these concerns with several examples: various research projects involving mousepox or influenza viruses arouse fears that "superviruses" could be newly created or rebuilt; these would be highly virulent and conventional vaccines would be ineffective. The research community itself has taken first steps against such risks: for example, when American researchers discovered a type of botulinum toxin that was novel to them, they held back certain genetic information from their publication. As it turned out later, however, the alleged new type was actually a hybrid of known botulinum toxins, which can be neutralized by conventional antitoxins. In retrospect, the incomplete publication of the research results met with criticism since the results of the work had been difficult to verify and valuable time had been lost. In another case, it was the National Science Advisory Board for Biosecurity (NSABB), which at first demanded from two researchers to withhold certain information: The scientists had changed the avian flu virus in a way that made air-born transmission between ferrets possible. After a second round of detailed discussion and careful weighing, the NSABB concluded that the researchers were allowed to publish their manuscripts in full after all.

Governments have also taken steps to prevent the potential misuse of life science research. The implemented measures greatly vary in scope: in Germany, they are limited to awareness-raising

Swiss Academy of Sciences (SCNAT)
Forum for Genetic Research
House of Academies | Laupenstrasse 7
P.O. Box | 3001 Bern | Switzerland
+41 31 306 93 35 | geneticresearch@scnat.ch
www.geneticresearch.ch

measures and a code of conduct. The US, on the other hand, has in addition set up a biosecurity body in the form of the NSABB, assesses the misuse potential of research projects as part of the funding process and has imposed a moratorium on research projects with certain pathogens. The Netherlands apply the principles of the so-called "Australian Group", which aims to prevent that exported goods contribute to the development of biological and chemical weapons by means of harmonized export controls, even in publications; this policy has led to the situation that one of the aforementioned scientists working on the avian flu virus had to apply for an export license before he could publish his results.

As the strongest instrument against the misuse of biological research, C. Invernizzi recommends strengthening a culture of responsibility among researchers. Researches should always question their own work according to the SWOT approach: Each project must analyze its strengths, weaknesses, opportunities and also the associated threats. Finally, the scientists should also be aware of their own "blind spots": a project can hold a potential for dual use, even if the involved researchers themselves do not see it that way.

**A different understanding of ethics**

On the panel participated the three life science researchers Hulda Jonsdottir (Virology, Institute of Virology and Immunology, University of Berne), Devang Mehta (Systems and Synthetic Biology, Institute of Molecular Plant Biology, ETH Zurich) and Fanny Georgi (Molecular Biology, Institute of Molecular Life Sciences, University of Zurich) as well as the philosopher and cultural scientist Michaela Egli (University of Zurich; think tank reatch), and the communications scientist and ethicist Sebastian Wäscher (Institute for Biomedical Ethics, University of Zurich). It became apparent that the humanists address the risk of misuse of biological research at a fundamental and more theoretical level. From the life scientists' point of view, on the other hand, the questions are primarily related to concrete projects, such as the discussion surrounding "gene drives", a technique that could possibly be misused to turn mosquitoes into bioweapons. But the ethical guidelines that had been provided to the young scientists had hardly raised their awareness for a possible misuse of their results. Rather, the ethical directives consisted of instructions not to falsify data and not to commit plagiarism. In general, however, the life scientists expressed their conviction that they were well informed to work safely. They and their colleagues were aware of their actions and assumed their responsibilities - even if they showed occasional black humor in the lab and would joke about the bad things they would be able to do, one participant said. The danger was more likely to come from persons outside science, for instance, if they could get into a laboratory without authorization. One participant remarked that, surprisingly, "dual use" was hardly ever discussed in medical practice, although it would also be an issue there.

**Life science research: No simple path to the desired result**

When asked how likely it was for terrorists to use the results of life science research towards their aims, the panel members differed in opinions. Some were convinced that there were much simpler ways to harm the general public: apart from laboratory equipment and in addition to the necessary knowledge, it would also require years of training - and even then the desired results would not be guaranteed. However, in view of the great destructive potential that a once-developed pathogen might have, other participants were not reassured by the assumption that biological research was too demanding for terrorists. Furthermore, it was argued that knowledge and technology from the life sciences were presumably also used and further developed by government agencies for war purposes. At least once participant considered this type of threat as even more worrying.



Swiss Academy of Sciences (SCNAT)
Forum for Genetic Research
House of Academies | Laupenstrasse 7
P.O. Box | 3001 Bern | Switzerland
+41 31 306 93 35 | geneticresearch@scnat.ch
www.geneticresearch.ch

**Look at your own research with a stranger's eyes**
When asked how the young researchers would proceed, if they had to establish or rule out the misuse potential of their projects, the answers also differed. Some objected to the idea of having to think like a criminal and to stimulate their imagination with criminal energy - because that is exactly what would be necessary to envision the possible misuse of a research project. Others, on the other hand, thought it would be useful to look beyond their own horizons in order to anticipate risks - even if it meant that they would mentally slip into the skin of a criminal. What we regard as harmless today may turn out to be risky later; therefore, it is important to anticipate risks far ahead.

**Expectations towards the scientific community**
In the view of the participants, to become a trustworthy scientist should be an urgent goal - or as a panelist put it: one should try to keep the evil away from one's own life. It is also important to be aware of one's own values. The same person did think nothing of forced training and communication measures, and also warned that it was too demanding to take responsibility for everyone and everything. The other panelists agreed, with certain reservations: indeed, not everyone could be burdened with everything but it's all about finding a pragmatic approach, which proves itself in practice. However, communication is important to find a common language and training is needed, someone objected. It might even be useful for scientists to visit a kindergarten to talk with the little ones. One person referred to their experience in establishing a dialogue between ethicists and life scientists, which had not worked out: While the humanists had expected the biologists to read articles and books and then think about and discuss them, researchers from the life sciences wanted practical suggestions. The exaggerated theoretical approach proved to be unsuitable for the practitioners from the laboratory; several of the participants pointed out that a wrong approach could ultimately even be counterproductive.

**The advantages of open communication are considerable**
More and more research results are published online today, sometimes without prior peer review. A person from the panel suggested that consequently some caution should be exercised, at least when it comes to publishing work on human pathogens. Another added that criminals could also search for information more intensively if they saw that a certain area was being researched. Not everyone agreed with this view: terrorists could hack into anything anyway, and the positive potential of open communication largely outweighs its possible disadvantages. Also, more failed experiments and negative results should be published.

There was much to discuss about the trend towards a "tabloidization" of science communication: researchers appear to be partly following the same rules as journalists, giving their work a personal touch and "hyping" their results. Hence, in communication with society, there is a need for qualified scientific journalists to make a selection of relevant information.

But communication within the scientific community is also problematic, added a person on the panel. It wouldn't be in a researcher's interest to explicitly point to risks and a possible misuse potential in his grant proposal. Even though researchers want to communicate honestly, they also want to stay in business. Open communication of problems could potentially be harmful to one's career.



Swiss Academy of Sciences (SCNAT)
Forum for Genetic Research
House of Academies | Laupenstrasse 7
P.O. Box | 3001 Bern | Switzerland
+41 31 306 93 35 | geneticresearch@scnat.ch
www.geneticresearch.ch

**Possible precautions to prevent misuse**
A system that allows researchers to disclose the risks and uncertainties of their research without fear of negative consequences was cited as an important element to prevent misuse. A person from the panel pointed out that calls for research proposals could explicitly invite critical thinking and request applicants to name and investigate possible risks of their own research. If reflections on and research into biosafety and biosecurity were rewarded with extra funding, this could contribute to safer and securer biological research.

Other participants highlighted the importance of an exchange between different stakeholders, most preferably on an international level. Much can be learned from considering the arguments of persons with differing opinions, and the differences sharpen the awareness of one's own values. In the opinion of a member of the panel, appropriate infrastructure in the research institute contributes much to a productive culture of discussion - for example, a room where one can meet and enjoy coffee. In addition, the participants wish competent persons responsible for biosafety and biosecurity, which also pay attention to access restrictions and locked doors.

Finally, it was emphasized how important it was that the regulating authorities employed well-educated experts. According to several participants, only those who are well acquainted with the laboratory practice could elaborate appropriate safety and security regulations, which would then be followed – for it is decisive that safety-and security-conscious behavior is anchored in the daily routine. In this sense, the pragmatic approach of Switzerland was commended, which, for example, does not request for every single genetically modified plasmid to be registered individually.



**Swiss Academy of Sciences (SCNAT)**
Forum for Genetic Research
House of Academies | Laupenstrasse 7
P.O. Box | 3001 Bern | Switzerland
+41 31 306 93 35 | geneticresearch@scnat.ch
www.geneticresearch.ch