



GENE TECHNOLOGY REPORT

An Interdisciplinary Research Group
of the Berlin-Brandenburg
Academy of Sciences and Humanities



berlin-brandenburgische
AKADEMIE DER WISSENSCHAFTEN



More knowledge
for an informed
debate



Does genetic engineering present an opportunity to develop better medications, to improve crop yields, and to increase economic growth? Or does it present an incalculable risk to our health, the environment, and social cohesion? Genetic engineering has revived the age-old conflict about progress as a blessing or a curse - more so than any other technological innovation in recent years. The reasons for this are obvious: Genetic engineering affects the most diverse areas of life; it allows us to directly modify genetic material – in the environment and in the human body. This is a frightening notion for many people. In light of these issues, the interdisciplinary research group 'Gene Technology Report' of the Berlin-Brandenburg Academy of Sciences and Humanities aims to provide a basis for an impartial and open discourse on genetic engineering in Germany. The research group, comprising renowned scientists from the human sciences, natural sciences and social sciences, is acting as an impartial, long-term 'observatory' to provide careful appraisal of the various applications of genetic engineering and to closely monitor its development. The latest technical developments are being studied, alongside the diverse areas where genetic engineering is employed. The economic, ecological and scientific aspects of specific applications of these technologies are being appraised by the research group, as well as ethical, political, and social factors. ■





Indicators – the tool of the Gene Technology Report



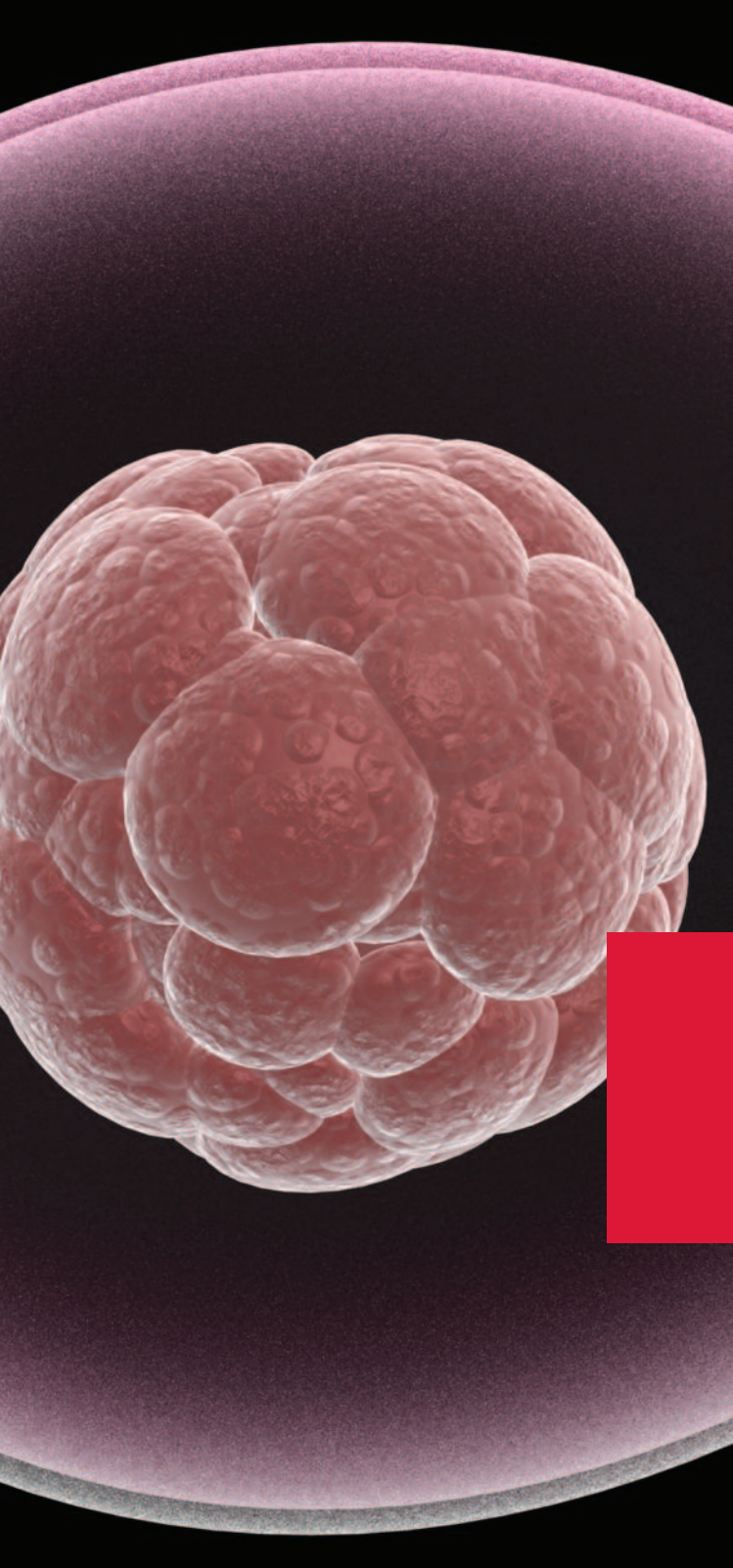
There is a vast amount of data and analyses relating to genetic engineering available, and precisely this complexity proves a hindrance to drawing unambiguous conclusions. In order to shed light upon this tangle of information, suitable indicators have been and will be selected. With the help of those indicators facts can be presented which would otherwise be impossible to gauge directly. For example, the significance of genetic engineering and its various applications can be effectively described and analysed using an array of different indicators and data. The research group 'Gene Technology Report' does not itself produce the required primary data, but uses available publications and data sources for evaluation and analysis.

*"The Gene Technology Report is a monitoring project. **Monitoring** should not be defined as supervising a relevant development to serve specific interests - it represents a tool for transparency, a 'confidence-building measure'." Gen-technologiebericht 2005, page 11*

The research group 'Gene Technology Report' documents its results and recommendations pertaining to politics, science and economics in a series of publications which began with the first German Gene Technology Report in 2005. With its interdisciplinary approach, this series aims to play a role in moderating the public debate. ■

*“Research on pluripotent stem cells is an expanding, highly competitive and internationally interconnected research field which is about to become a key technology in biomedicine.”
Zweiter Gentechnologiebericht 2009, page 105*

Over the past 25 years, significant findings have been made in the field of cell biology and developmental biology. 'Dolly', the famous cloned sheep, is just one milestone among many others. Due to the great potential that stem cell research has for future strategies in regenerative medicine, great efforts are required in terms of scientific, financial and organisational considerations. The success of these efforts will depend on the general socio-political conditions and the underlying legal framework. An important factor will be the realization of a responsible discussion of ethical principles and the engagement of informed professionals in order to communicate and establish new technologies in the public realm. The research group's objective remains to process, via indicators, the state of knowledge and technology as well as describing individual fields of application such as basic and applied research, stem cell therapies, or focussing on the ethical implications and legal framework of research using human embryos. ■



“Molecular genetic diagnosis is one application of genetic engineering that has acquired a position of prime importance in standard medical practice today. This trend will continue and gain momentum in the foreseeable future.”
Gentechnologiebericht 2005, page 263

For example, genetic testing allows us to determine the genetic causes of, or dispositions to, diseases a long time before the potential or actual outbreak. Here a distinction must be drawn between genetic testing to diagnose a specific disease and genetic testing to prognosticate a genetic risk. Genetic testing is currently the most important application of genetic engineering in medicine. This has two main reasons: Firstly, there are very few diseases in which the genes are not involved as a cause. Secondly, genetic testing is developing at breathtaking speed. At the same time, the unforeseeable diagnostic possibilities are causing many people concern, as the debate on prenatal diagnosis has shown. The research group documents the scientific and technical development of genetic testing and its possible applications including its legal implications. Additional points include: the forensic applications of molecular genetics, preimplantation genetic diagnosis, the health-economical aspects and the possibility of preventive coercion. ■

GCTGCTGCTCTCCGGGGCC
GAGCATATGCAGGAAGCGG
GGACCTCCCAGGCCAGTGC
TCCTGCAAATAAAACCTCA
GCTGCTGCTCTCCGGGGCC
GAGCATATGCAGGAAGCGG
CCCCCCCAGCAATCC
GGCCCC
CGC
GCTG
GAGCA
GGACCTC
CGCA
TCCTC
GCTG
GAGCA
GGACCTC
CGCACCCCC
TCCTGCAAATAAAAC
GCTGCTGCTCTCCGGGGCC
GAGCATATGCAGGAAGCC
GGACCTCCCAGGCCAGTG



*“Ethical concerns advise **gene therapy** currently only for most severe or life threatening conditions which lack alternative therapeutic measures.” Genterapie in Deutschland 2008, page 20*

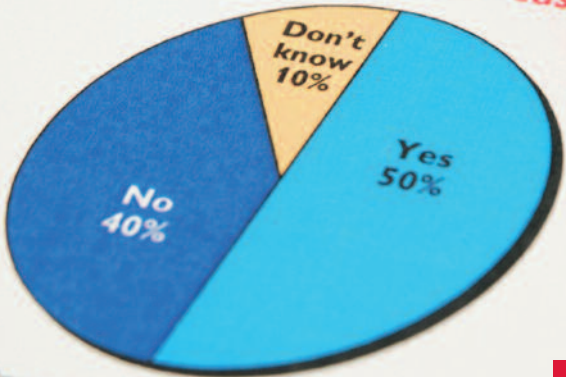
Gene therapy is another important field of genetic engineering, where genes are introduced into a patient's cells for therapeutic measures or vaccination. The introduction of the foreign DNA material is termed gene transfer and utilizes specialized gene carriers termed vectors. The development of gene therapy vectors is currently a main focus of research. As for the indications of gene therapy, clinical studies target foremost oncological illnesses, followed by cardiovascular, monogenic and infectious diseases. Gene therapy can aim to modify somatic cells or germ cells. Somatic cells are all cells of the human body which are not germ cells. Their DNA content is not passed on to the next generation. By contrast the term germ cell refers only to the egg and sperm cells. Any change in the DNA content of these cells would be passed onto to the next generation. Germ line gene therapy is prohibited by law in Germany.

The research group examines procedures and methods of gene therapy in both fundamental and applied research including judicial, economical, ethical and social aspects as well as the public perception and opinion in Germany. ■



Percentage of Respondents

information on your customer



Percentage of Respondents

tain information about multiple
and family relationships?





*“**Synthetic biology** is a newly emerging field of research which includes elements of molecular biology, microbiology, genetic engineering, organic chemistry, computer science and classic engineering.” www.gentechnologiebericht.de*

This young research field has gained considerable publicity since the press release by Craig Venter in May 2010 announcing the successful construction of the first synthetic bacterial cell. The recent scientific advances have fuelled visions of artificial life created willfully in laboratories and profitable, custom-tailored microbes which will produce biofuels, pharmaceuticals, and commodities such as food in the future. The research group will take a closer look at the promises of synthetic biology. It will review the many definitions of this discipline and show the current developments in research and technology in Germany. Future applications as well as the current public perception in Germany will be discussed. Another strong focus of the group will be the ethical aspects of man-made life forms and their impact on our understanding of the natural and the artificial. ■

*"The question as to whether the implementation of **GM plants and GM food** will fail due to lack of consumer acceptance has yet to be answered." Zweiter Gentechnologiebericht 2009, page 336*

No other aspect of genetic engineering is so controversial in this country - or in the rest of Europe – as the cultivation and use of genetically modified plants. Nevertheless, genetic engineering for agriculture is continuing to develop globally at breathtaking speed and breeders are already working on second and third generation genetically modified plants. Among these are plants for healthier nutrition (functional food), for medical use (Plant-Made Pharmaceuticals), or those used in the chemicals industry (Plant-Made Industrial Products). The research group reviews the current state of technological development of genetic engineering for agriculture technology and its applications. The debate on the associated risks in their legal, social, political, economic, ecological and ethical aspects is focused, too. ■





Over the coming years, the research group will also examine the issue of **epigenetics**: The inheritance of acquired traits was for a long time a taboo issue that Epigenetics has once more brought to the fore. This research field analyses inherited characteristics of cells which are not determined by their DNA sequence. The research group is going to monitor future developments of this field under consideration of ethical and social dimensions. ■

Forschungsberichte
der Interdisziplinären Arbeitsgruppen der
Berlin-Brandenburgischen
Akademie der Wissenschaften

Gentechnologiebericht

Analyse einer Hochtechnologie in
Deutschland

...ho, Klaus Brockhoff, Wolfgang van den Daele,
Jens Reich, Hans-Jörg Rheinberger,
...über, Karl Sperling, Anna M. Wobus,
...n, Meike Kölsch



BERLIN-BRANDENBURGISCHE AKADEMIE
DER WISSENSCHAFTEN



Deutschland

Kurzfassung

Recent Publications (only in German)

Müller-Röber, Bernd; et al.: Zweiter Gentechnologiebericht. Analyse einer Hochtechnologie in Deutschland. Dornburg, 2009.

Hucho, Ferdinand; et al.: Gentherapie in Deutschland. Eine interdisziplinäre Bestandsaufnahme. Themenband zum Gentechnologiebericht. Dornburg, 2008.

Schmidtke, Jörg; et al. (Hrsg.): Gendiagnostik in Deutschland. Status quo und Problemerkundung. Supplement zum Gentechnologiebericht. Limburg, 2007.

Müller-Röber, Bernd; et al.: Grüne Gentechnologie. Aktuelle Entwicklungen in Wissenschaft und Wirtschaft. Supplement zum Gentechnologiebericht. München, 2007.

Wobus, Anna M.; et al.: Stammzellforschung und Zelltherapie. Stand des Wissens und der Rahmenbedingungen in Deutschland. Supplement zum Gentechnologiebericht. München, 2006.

Hucho, Ferdinand; et al.: Gentechnologiebericht. Analyse einer Hochtechnologie in Deutschland. München, 2005.



Using an interdisciplinary approach to examine the current state of development of the various branches of genetic engineering in Germany

Upcoming Publications

- ▶ Grüne Gentechnologie. 3. völlig neubearbeitete und ergänzte Auflage, 2011.
- ▶ Genterapie in Deutschland. 2. aktualisierte und erweiterte Auflage, 2011.
- ▶ Synthetische Biologie, planned for 2012.
- ▶ Dritter Gentechnologiebericht, planned for 2013.
- ▶ Epigenetik, planned for 2014.

Members of the Research Group

Prof. Dr. Bernd Müller-Röber* (Coordinator)

University of Potsdam, Institute of Biochemistry and und Biology

Prof. Dr. Ferdinand Hucho* (Vice Coordinator)

Free University of Berlin, Institute of Chemistry and Biochemistry

Prof. Dr. Nediljko Budisa

Berlin Institute of Technology (TU Berlin), Department of Chemistry, Biocatalysis Group

Prof. Dr. Boris Fehse

University Medical Center Hamburg-Eppendorf, Bone Marrow Transplantation Unit

Dr. Jürgen Hampel

Stuttgart University, Institute of Social Sciences

Prof. Dr. Dr. Kristian Köchy

University of Kassel, Institute of Philosophy

Prof. Dr. Jens Reich*

Max Delbrück Center for Molecular Medicine, Berlin-Buch

Prof. Dr. Hans-Jörg Rheinberger*

Max-Planck-Institute for the History of Science, Berlin

Prof. Dr. Hans-Hilger Ropers*

Max-Planck-Institute for Molecular Genetics, Berlin

Prof. Dr. Jochen Taupitz

University of Mannheim, Department of Law

Prof. Dr. Jörn Walter

Saarland University, Department of Bioscience, Epigenetics

* Member of the Berlin-Brandenburg Academy of Sciences and Humanities

The current state of the series and certain texts can also be found on our website:

<http://www.gentechnologiebericht.de/gen/english-pages>

The website also provides information about current and upcoming lectures, workshops and conferences.

Head of Office

Dr. Silke Domasch

E-Mail: domasch@bbaw.de

Telephone: 030 20 370 626

Team

Julia Diekämper

E-Mail: diekaemper@bbaw.de

Telephone: 030 20 370 624

Dr. Anja Hümpel

E-Mail: huempel@bbaw.de

Telephone: 030 20 370 624

Dr. Lilian Marx-Stölting

E-Mail: marx-stoelting@bbaw.de

Telephone: 030 20 370 625

Berlin-Brandenburg

Academy of Sciences and Humanities

Interdisciplinary Research Group

Gene Technology Report

Jägerstraße 22/23, 10117 Berlin, Germany

www.gentechnologiebericht.de

Fax: 030 20 370 444

This publication was produced with support from the Berlin Senate Administration for Education, Science and Research and the Brandenburg Ministry for Science, Research and Culture.