



# Europäische Akademie

zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen  
Bad Neuenahr-Ahrweiler GmbH

Direktor:  
Professor Dr. Carl Friedrich Gethmann

# Newsletter

Akademie-Brief ▪ No. 41 (September 2003)

## Editorial

Seit ihrer Gründung im Jahre 1996 bietet die Europäische Akademie insbesondere Künstlern aus der Region Gelegenheit, ihre Werke in den Räumen der Akademie auszustellen. In den bisher 16 verschiedenen Kunstausstellungen wurden Bilder, Skulpturen und Film- bzw. Tonbänder vorgestellt. Für die letzten beiden Ausstellungen von Frau Ursula Witzlau und Herrn Günther Winkler zeichnet der Verein der Förderer der Europäischen Akademie verantwortlich, der seit Anfang des Jahres 2003 die Vernissagen trägt.

Unter den regionalen Künstlern sind bekannte Namen wie Titus Reinarz und Bobo Kriechel zu finden. Von beiden Künstlern hat sowohl das Land Rheinland-Pfalz als auch die Bundesrepublik Deutschland Werke angekauft. Ein Werk des Künstlers Bobo Kriechel hat das Land Rheinland-Pfalz der Europäischen Akademie als Leihgabe zur Verfügung gestellt. Die vom Künstler Titus Reinarz geschaffene Skulptur „Europa“ wurde der Akademie anlässlich des Umzugs in die neuen Räume von der Kreissparkasse als Dauerleihgabe überlassen. Gegenwärtig ist die eine Ausstellung der Werke von Günther Winkler zu sehen.

Der Newsletter berichtet regelmäßig über die Vernissagen.

## Focus

### Definitions of Nanotechnology – Who needs them?

Michael Decker

Nanotechnology is getting more and more in the focus of public debate. Different NGO's have composed first statements on the topic, newspapers report on the findings of Nanotechnology and on its potential consequences. Within that discussion, it is often deplored that there is no common definition of Nanotechnology. In this contribution, existing definitions of Nanotechnology are discussed. It is demonstrated that they are not optimised for operationalisation. Finally, it is identified that there might be no way to find one general definition of Nanotechnology but that different definitions have to be developed referring to the needs of those, who will use them, e.g. research founders or technology assessors.

#### Introduction and public debate

Nanotechnology (NT) nowadays fulfils all criteria to become a key technology. The United States and Japan as well as the European Union have identified NT as an area which plays a decisive role concerning the economic competition within near and remote future. The United States and Japan both have planned to spend around 800 Mio Dollar on NT next year – Germany spends around 200 Mio Euro on it per year.

The public perception concerning NT is increasing as well. One can find favourable views like in the cover article "Neue Macht" (Bild der Wissenschaft 10/2002) as well as critical contributions like "Der Phantasie-Utopie-Angst-Komplex" (Frankfurter Allgemeine Zeitung (FAZ), 21.7.03). Also the Neue Zürcher Zeitung (NZZ) captions "Nach Atom und Gen kommt Nano" (NZZ, 18.7.03) and mentions that NT could be the next „candidate“ for public counter-campaigns after nuclear power and gene technology. In this article, the NZZ refers to a report from the ETC-group (Action Group on Erosion, Technology and Concentration) in which an immediate moratorium for commercial production of new nanomaterials is demanded ("The Big

Down. From Genoms to Atoms", 01/2003). The ETC-Group justifies this demand referring to the unsolved question concerning the toxicity of nanoparticles. This aspect dominates the public debate on consequences of NT (Deutschlandradio, 17.6.03). Greenpeace combined in its report NT and robotic/artificial intelligence research (A. H. Arnall, "Future Technologies, Today's Choices. 07/2003). In the conclusions of both reports a comprehensive analysis of the consequences of NT is demanded and recommended: ETC-Group asks "To launch a transparent global process for evaluating the socio-economic, health and environmental implications of the technology" and Greenpeace recommends "The way in which these more fundamental changes might impact on the environment would have to form the basis of a much larger technology assessment, in which long-term structural changes to global industry and commerce were considered."

Thus a Technology Assessment (TA) of NT has been recommended. TA can be described as reflective research which means literally that it reflects "on something". Therefore it needs a definition of NT first, to have a well defined object to reflect on.

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However, such a sharp definition of NT does not exist. The historical development of NT, initialized by the famous talk of Richard Feynman ("There is plenty of room at the bottom", 1959), refers to what would nowadays be called "bottom-up" approach because it explicitly mentions the direct manipulation of atoms: "What would the properties of materials be if we could really arrange the atoms the way we want them [...]. Atoms on a small scale behave like nothing on a large scale, for they satisfy the laws of quantum mechanics". The "bottom-up" approach is complemented by the "top-down" approach, which aims at further miniaturization of micrometer size devices. Electronics can be taken as a paradigm for the ongoing miniaturization process of a technology.

### Definitions of Nanotechnology

In the following, different definitions of NT will be mentioned and discussed.

#### Definition 1

Nanotechnology are "areas of technology where dimensions and tolerances in the range of 0.1 nm to 100 nm play a critical role". (Glossary, [www.nanoforum.org](http://www.nanoforum.org))

This definition takes the notion NT literal and refers directly to the length scale which can be taken as "name-giving" for NT. However, in this definition it is the "critical role" which needs further explanation. It is remarkable that the range starts from 0.1 nm and ends at 100 nm. For some reasons the usual nanometer-interval of the SI-System (Système International) has been shifted by one decimal power.

In most cases, the specification of size is complemented with additional descriptions. The following definition combines the bottom-up and the top-down approach with size considerations:

#### Definition 2

Nanotechnology describes the creation and utilisation of functional materials, devices and systems with novel functions and properties that are based either on geometrical size or on material-specific peculiarities of nano-structures. Purely geometrically the prefix "nano" describes a scale 1000 times smaller than that of present elements of the micrometer-sphere. This scale has become accessible both by application of new physical instruments and procedures and by further diminution of present microsystems. Also structures of animated and non-animated nature were used as models for self-organising matter. ([www.nanoforum.org](http://www.nanoforum.org))

This definition tries to reach a kind of completeness in describing NT. It takes into account functional materials, devices and systems and refers explicitly to novel func-

tions and properties and mentions self-organisation and Nanobiotechnology.

#### Definition 3

The object of Nanotechnology is the production and application of structures, molecular materials, internal and external surfaces in critical dimensions or production tolerances of some 10 nm to atomic measurement. [...] The aim is the preparation of material dependent properties of solids and their dimensions and new functionalities based on new physical-chemical-biological impact principles, caused by the submicroscopic resp. the atomic or molecular area. [...] Nanotechnology is dealing with systems with new functions and properties which depend solely on nanoscale effects of their components. (Bachmann 1998 "Innovationsschub aus dem Nanokosmos"; translation Michael Decker)

This definition adds two new things to our discussion. Firstly, the physical-chemical-biological impact principles are mentioned and secondly, the nanoscale effects which cause the new functions and properties. Moreover, the material optimization is explicitly mentioned here.

#### Definition 4

Object of Nanotechnology is the production, analysis and application of functional structures whose scales are in the area of below 100 nm. [...] An atom or a molecule does not show the physical properties we are "used to" like electrical conductivity, magnetism, colour, mechanical rigidity or a certain melting point. [...] Nanotechnology is taking place in the intermediate area between individual atoms or molecules and larger ensembles of atoms and molecules. In this area new phenomena appear which cannot be encountered in macroscopic devices. (BMBF 2002, Standortbestimmung: Nanotechnologie in Deutschland, translation Michael Decker)

This definition mentions physical properties well known from macroscopic devices which change at the nanometer level. Therefore, these "new phenomena" cannot be found in the macroscopic area.

Reading these definitions, one gets a good impression of what NT is about. All definitions refer explicitly to the size. The description of the relevant size ("below 100 nm") is maybe the most pragmatic way to define NT. New effects, phenomena or functions described take place around and within this order of magnitude. However, it remains to be arbitrary, because there is no direct causality from size to these effects or functions. That is why most definitions complement the specification of the length scale with the reference to these effects/phenomena (def. 3, 4) or the new

functions (def. 2). It seems that in both cases nearly the same is meant. On the one hand side, one focuses on the function of a nano-system and refers to the technology context and the future use of the nano-devices thereby. On the other hand, effects or phenomena refer to a natural science context. One can identify specific physical-chemical-biological effects/phenomena which can be allocated to NT. Due to the fact that new functions of nanodevices are usually based on these scientific effects or phenomena, this can be taken as two sides of the same coin.

However, the impression what NT is about remains to be fuzzy, because it is never explained in detail what the conditions for these new functionalities are. Here, it is not helpful to know that the new functionalities are caused by the nanoscale size of the device. Only def. 5 refers to how a definition of NT can be operationalised, namely in relation to physical properties. However, even using def. 5 one would face a problem when the decision is at stake whether a concrete phenomenon should be labelled as NT. Because one would have to demonstrate that a physical property "we are used to from macro-scale devices" is not observable or, the other way round, that a new phenomenon appears which is not known from macro-size artefacts.

### Who needs a definition of Nanotechnology?

First of all, it should be mentioned that it are not the nanoscientists themselves who need such a definition. In fact, for them it is less important if the research they do in their laboratories is allocated to NT or not. Here, they mainly follow their research aims. This changes when we talk about the funding of research. Nowadays, the possibility for a scientist to allocate her or his research to NT is very valuable because it opens the path to the huge funds mentioned in the introduction. Definitions of NT or even of sub-categories become relevant in the context of regulation, too. Coming back to the moratorium demanded by the ETC-group, it becomes crucial whether a research proposal aims at the "commercial production of new nanomaterials".

These examples point to the fact that definitions are made in order to reach certain ends. There are no right or wrong definitions, only more or less purposeful ones. First of all, one has to mention explicitly what the ends of a definition are. In most of the above mentioned cases this is lacking. In general, the aim of a definition is to "distinguish something". If the German Federal Ministry for Education and Science decides to fund research on NT it needs criteria to distinguish research pro-

posals which belong to NT from those which do not. And if scientists modify their proposals in order to fulfil these criteria one major aim of the ministry is reached: It has shaped the German research area.

The same is valid for TA on Nanotechnology. As a reflecting research, it has first of all to identify the object to reflect on. Taking the variety of research which can be found under the heading NT today, it becomes obvious that TA of NT in general can not be a realistic endeavour. Therefore, a TA-project has to start with the identification of a subset of research within NT before its consequences can be assessed.

This paper is partially based on findings within the work of the study group "Miniaturization and Material Properties" which is currently busy with developing an operational definition of Nanotechnology. The results will be published within the "Graue Reihe" of the Europäische Akademie in autumn 2003.

Dr. Michael Decker is a former member of the scientific staff of the Europäische Akademie. He is now with the Institute for Technology assessment and System Analysis of the Research Centre Karlsruhe. In addition, he is the manager of the Europäische Akademie's study group "Miniaturization and Material Properties".

## Working Groups

### Miniaturization and Material Properties

The study group „Miniaturization and Material Properties" held meetings from 26<sup>th</sup> - 27<sup>th</sup> June and from 17<sup>th</sup>-18<sup>th</sup> July in Bad Neuenahr-Ahrweiler as well as on 7<sup>th</sup> August 2003 in Frankfurt. Based on the existing contribution drafts to the forthcoming "Graue Reihe" report, its members discussed a new definition of Nanotechnology. This definition takes into account former attempts to define the respective field of science and relates to both the appearance of non-classical physical effects and the lateral scale dimensions in the nanometer regime. The study group also devised an organisational pattern for the report to be published in autumn. Areas of research and technology that are currently being considered as belonging to Nanotechnology will be presented in a structured table and then be separated into two sub-tables, reflecting their compatibility to the definition mentioned above. The table entries will be discussed one by one, clarifying their contents and justifying their sub-table assignment. These text blocks will be headed by general considerations concerning the purpose of definitions. Economic points of view will be furnished as well.

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## News

### Kreissparkassenvortrag

Im Rahmen der Kreissparkassenvorträge, die die Europäische Akademie in Zusammenarbeit mit der Kreissparkasse Ahrweiler veranstaltet, wird Professor Reinhard Merkel am 13. Oktober um 19:30 Uhr im SETA Hotel einen Vortrag zum Thema „Gerechter Krieg? Ethische und juristische Überlegungen zum Begriff der 'humanitären Intervention'" halten. Der Referent ist Professor für Strafrecht und Rechtsphilosophie an der Universität Hamburg.

### Zukünftige Klimaänderungen als Herausforderung für die deutsche Wirtschaft

Am 28. Juli 2003 fand ein Treffen im Bundesministerium für Bildung und Forschung (BMBF) zu dem o.g. Thema statt, dass an das gleichnamige Fachgespräch vom 24. Februar 2003 an der Europäischen Akademie anknüpfte (siehe hierzu Newsletter-Ausgabe 23). Ziel dieses Folgetreffens waren weitere Konkretisierungen aus industrieller Sicht. Unter anderem scheint die Notwendigkeit „klimafreundlicher" Prozess- und Produktinnovationen insbesondere für die Sparten Chemie, Stahl, Zement und Elektrizität gegeben zu sein. Die DECHEMA wird den weiteren Spezifizierungsprozess hierzu koordinieren.

### Side-events to the international „Renewables 2004" conference in Bonn from 1<sup>st</sup> - 4<sup>th</sup> June 2004

The CIC Bonn GmbH coordinates an initiative to enhance public interest to the above mentioned conference and its topic by a series of side-events from autumn 2003 on. The relevant institutions of the region around Bonn may contact CIC for inclusion into the respective workshop, seminar or excursion programmes on renewable energy and energy efficiency as well as for further cooperation. A corresponding information meeting was held on 29 July 2003; a second organisational meeting is planned for September 2003.

### Junge Akademie

Vom 17.-19. August fand zum Thema "Zur Deutungsmacht der Biowissenschaften" in den Räumen der Europäischen Akademie eine Sitzung der Arbeitsgruppe der Jungen Akademie an der Berlin-Brandenburgischen Akademie der Wissenschaften und der Deutschen Akademie der Naturforscher Leopoldina statt.

Die Arbeitsgruppe der Jungen Akademie diskutierte neuere Ansätze der Soziobiologie bzw. Evolutionären Psychologie, die von Autoren wie z.B. Dennett, Pinker, Tooby und Cosmides vertreten werden.

In seinem Vortrag "Zum Erklärungsanspruch der Biowissenschaften" stellte

Priv.-Doz. Dr. Andreas Hüttemann, Bielefeld, verschiedene Modelle für wissenschaftliche Erklärungen in den Biowissenschaften dar, und erläuterte anhand dieser Modelle die Schwächen der von Dennett und Pinker gegebenen Erklärungen für menschliches Verhalten.

In seinem Beitrag "Evolution und Ethik" argumentierte Dr. Felix Thiele, dass die (teils impliziten) Versuche Dennetts und Pinkers auf evolutionstheoretischen Ansätze eine Ethik zu gründen, auf nur schlecht begründeten naturalistischen Argumenten beruhen.

Weitere Mitglieder der Arbeitsgruppe, die an der Sitzung teilnahmen, waren: Dr. Julia Fischer, Leipzig, Dr. Christoph Halbig, Münster, Professor Dr. Doris Kolesch, Berlin, Priv.-Doz. Martin Korte, München.

## Call for Abstracts

### Workshop: "International Justice II"

The above mentioned workshop will be held at ISSEI 2004 (International Society for the Study of European Ideas), IX. International Conference which will take place at the University of Navarra (Pamplona, Spain) from 2<sup>th</sup>-7<sup>th</sup> August 2004. The workshop is organised by Dr. Doris Schroeder, Centre for Professional Ethics, University of Central Lancashire, Preston, PR1 2HE, United Kingdom and Dr. Milos Liakopoulos, Europäische Akademie zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen Bad Neuenahr-Ahrweiler GmbH, Wilhelmstr. 56, 53474 Bad-Neuenahr Ahrweiler, Germany.

As a follow-up to the "International Justice" workshop at ISSEI 2002 in Aberystwyth, the organisers would like to invite papers on the theme of "International Justice II - Benefit Sharing with Developing Countries".

The ethical principle of justice forbids the inequitable exploitation of resources. There is an almost universal feeling that it would be unfair if an affluent country removed or used resources from a poorer country without - at least - paying adequate compensation. This idea has been incorporated into various international guidelines, most notably the Bonn Guidelines of the Convention on Biological Diversity (2002) and the Human Genome Project Ethics Committee's Statement on Benefit Sharing (2000). The former deals with the exploitation of flora and fauna, whilst the latter is concerned with the use of human resources (e.g. human genetic material, clinical trials in developing countries).

Please send an abstract of no more than 300 words to Doris Schroeder (dschroeder@uclan.ac.uk). Deadline: 15 December 2003. More information on ISSEI can be found at: <http://www.unav.es/cee/issei/default.html>

**Art**

Von September 2003 bis März 2004 sind die Bilder des expressionistischen Malers Günter Winkler in den Räumen der Europäischen Akademie ausgestellt. Günter Winkler ist ein Schüler von Karl Schmidt-Rottluff, dem Mitbegründer der Künstlergemeinschaft „Die Brücke“. Über diese Gemeinschaft ergaben sich auch Kontakte zu Emil Nolde und Oskar Kokoschka. Herr Winkler lebt und arbeitet als freischaffender Maler und Dozent auf der Insel Sylt. Die Werke des Künstlers können täglich zwischen 9:00 und 16:00 besichtigt werden.

**Publications**

The English translation of the volume 5, "Umweltstandards. Kombinierte Expositionen und ihre Auswirkungen auf den Menschen und seine natürliche Umwelt" was published recently:

C. Streffer, J. Bücken, A. Cansier, D. Cansier, C.F. Gethmann, R. Guderian, G. Hanekamp, D. Henschler, G. Pösch, E. Rehlinger, O. Renn, M. Slesina, K. Wuttke, Environmental Standards. Combined Exposures and Their Effects on Human Beings and Their Environment, Springer Verlag, Berlin, 2003, ISBN 3-540-44097-6

Minou-Bernadette Friele

"Do Committees Ru(i)n the Biopolitical Culture? On the Democratic Legitimacy of Bioethics Committee", in: *Bioethics*, Vol. 17 No.4 August 2003, Special Issue: Consensus in Public Bioethics Commissions, 301-319

Carl Friedrich Gethmann

"The Moral Status of the Embryo and the Protection of its Life", in: *Human Reproduction and Genetic Ethics*, (2003) Nr. 2, 38-40

"Epilogue: Can there be universal principles of circumspective concern towards our natural environment?", in: E. Ehlers / C.F. Gethmann (eds.), *Environment across Cultures*, Berlin 2003 (Wissenschaftsethik und Technikfolgenbeurteilung, Bd. 19), 205-211

"Entwicklungen in der Frühphase aufgreifen", Interview in: *Europäische Zeitung*, Juni 2003, 95-97

"A Call for Multiclass Medicine", Interview in: *livingbridges* 1/2003, 57

**Book Series**

The series *Wissenschaftsethik und Technikfolgenbeurteilung* (Ethics of Science and Technology Assessment) serves to publish the results of the work of the Europäische Akademie. It is published by the Academy's director. Beside the final results of the project groups, the series includes volumes on general questions of ethics of science and technology assessment as well as other monographic studies:

Vol. 8: J. P. Beckmann et al., Xenotransplantation von Zellen, Geweben oder Organen. Wissenschaftliche Grundlagen und ethisch-rechtliche Implikationen, 2000

Vol. 9: G. Banse, C. J. Langenbach, P. Machleidt (eds) Towards the Information Society. The Case of Central and Eastern European Countries, 2000

Vol. 10: P. Janich, M. Gutmann, K. Prieß (eds) Biodiversität. Wissenschaftliche Grundlagen und gesellschaftliche Relevanz (2001)

Vol. 11: M. Decker (ed) Interdisciplinarity in Technology Assessment. Implementation and its Chances and Limits (2001)

Vol. 12: C. J. Langenbach, O. Ulrich (eds) Elektronische Signaturen. Kulturelle Rahmenbedingungen einer technischen Entwicklung (2002)

Vol. 13: F. Breyer, H. Kliemt, F. Thiele (eds) Rationing in Medicine. Ethical, Legal and Practical Aspects (2002)

Vol. 14: T. Christaller et al. (eds) Robotik. Perspektiven für menschliches Handeln in der zukünftigen Gesellschaft (2001)

Vol. 18: U. Steger et al. Nachhaltige Entwicklung und Innovation im Energiebereich. (2002)

Vol. 17: C.F. Gethmann, S. Lingner (eds): Integrative Modellierung zum Globalen Wandel (2002)

Vol. 16: M. Schröder et al. (eds) Klimavorhersage und Klimavorsorge (2002)

Vol. 15: A. Grunwald, M. Gutmann, E. Neumann-Held (eds) On Human Nature. Anthropological, Biological, and Philosophical Foundations (2002)

**Personalities**

Professor Dr. Kornelis Blok (1956) studied experimental physics at Utrecht University and received a Ph.D. degree in 1991 on a thesis 'On the Reduction of Carbon Dioxide Emissions'.

In 1984 he was one of the founders of Ecofys. With its about 150 employees in six countries, the company is active in research, consultancy, project development and product development in the areas of energy efficiency improvement and renewable energy. As director of Ecofys, Professor Blok has special responsibilities for work in the area of Energy Strategy and Policy. He is also with Utrecht University since 1983. At present he is a professor of Science, Technology and Society. Besides, he is director research of the inter-university Netherlands' Research School for Environmental Sciences SENSE.

Professor Blok has extensive research and consultancy experience in the field of energy efficiency improvement and clean energy production, including renewable energy.

As a consultant, he developed proposals that were instrumental in the development of the European Union climate policy on the way to Kyoto. Later, he supervised the 'Sectoral Objectives' project that served as input for the European Climate Change Program. He also was a lead author for the Third Assessment Report of the Intergovernmental Panel on Climate Change.

Professor Blok was member of the Europäische Akademie's former project group "Sustainable Development and Innovation in the Energy Sector".

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