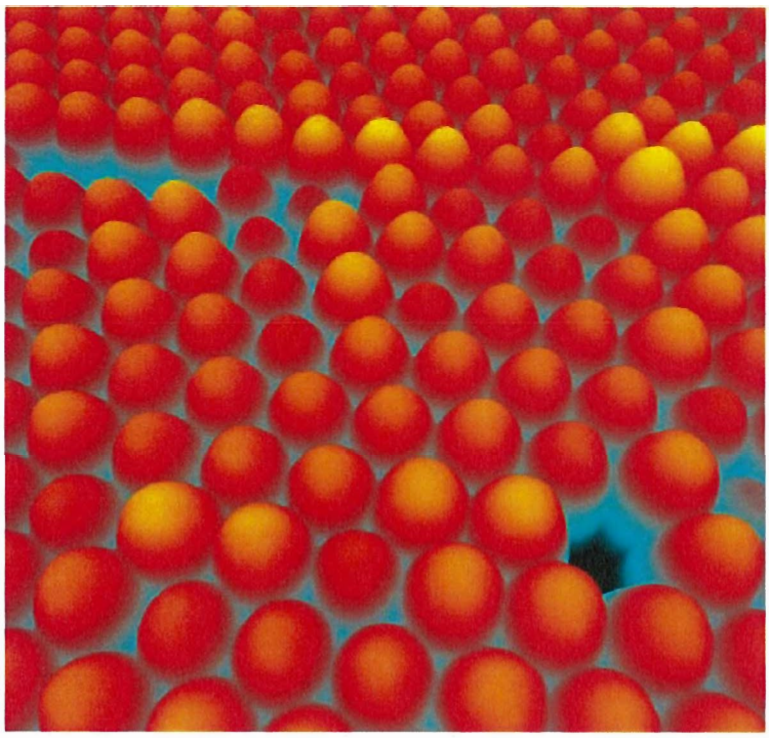
Public Nanotechnology Communication in Germany



Report by
Jennifer Millar

Australia Germany Association Educational Development Fellowship 2009

About The Author

Jennifer worked for four years as a Science Communicator at Western Australia's premier science and technology museum. During 2009 she was a member of the Outreach Team and travelled throughout Western Australia communicating science to people of all ages and backgrounds. She has also worked as a Science and Industry Analyst for Bridge8- a South Australian foresight and communications consultancy which focuses on education and public engagement in emerging technologies.

Jennifer holds a Bachelor of Science with a major in Physics and was awarded First Class Honours in Nanotechnology at Curtin University. Her Honours project investigated drug delivery to the brain using nanoparticles of a novel biodegradable polymer. In 2007 she received the Science and Innovation Studentship Award to carry out a research project examining polymeric ocular drug delivery.

Jennifer has passion for European cultures, particularly the German culture. She completed the final semester of her degree at the Technische Universität Darmstadt in 2007.

In August 2010 she will take up an exciting position as Science Communicator at the Deutsches Museum in Munich; Europe's largest science and technology museum. Jennifer will develop the nanotechnology communication program at the Centre of New Technologies, and has been invited to represent the museum at the NanoToTouch 3rd Consortium Meeting in Milan in September 2010.

Jennifer is also the recipient of a DAAD Scholarship (Deutsches Akademisches Austauschdienst) for 2011. The scholarship enables her to undertake a Master in Communication and Cultural Management at Zeppelin University on Lake Constance, later this year.

Cover Image: Atomic force micrograph 'Aesthetic Imperfections'
by Dr. Hans Danzebrink, Physikalisch-Technische Bundesanstalt, Braunschweig

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My parents, Peter and Margaret Millar, who still manage to provide me with all the support I need, despite being thousands of kilometres away. Without their support I would not be able to explore the world as I enjoy doing.

Contents

Introduction

In 1959, American physicist Richard Feynman gave a speech entitled "There's Plenty Of Room At The Bottom". This famous lecture explored the manipulation of matter on the atomic scale and signifies the introduction of the concept of nanotechnology and catalysed research in this field.

Nobel Prize winner Feynman postulated the possibilities presented by "manipulating and controlling things on a small scale". "It would be interesting in surgery if you could swallow the surgeon. You put the mechanical surgeon inside the blood vessel and it goes into the heart and 'looks' around". Feynman acknowledged this as a "wild idea", but in 2010 robots can be programmed to perform routine surgical procedures, and are continually moving closer to the mainstream.

Feynman also talked of improving the resolution of the scanning electron microscope, "so it should be possible to see the individual atoms". This idea was later realised by the scanning tunnelling and atomic force microscopes, developed in 1981 and 1986 respectively. In addition to providing higher resolution than the SEM, AFM generates a true 3-dimensional surface profile.

Miniaturising the computer was considered by Feynman as a very real possibility. "Computing machines are very large; they fill rooms...There is plenty of room to make them smaller". In 2010, miniaturising electronics to the nanoscale is being researched by scientists across the disciplines.

Fifty years after Feynman's ground-breaking speech, nanotechnology has emerged as one of the most promising interdisciplinary fields of technologies in the world. It has significant implications in the fields of electronics, modern medicine and the environment. It is therefore vital that effective communication techniques be used in order to raise awareness of the opportunities and potential of nanotechnology, and to provide the public with balanced and factual information.

Germany provided the perfect setting for research into nanotechnology communication. In 1998 the Federal Ministry of Education and Research (BMBF) announced a five-year funding agreement entitled 'Nano-Initiative – Aktionsplan'. This contract defined the nation as the European leader in nanotechnology Research and Development (R&D). The BMBF, headed by Dr Annette Schavan, contributes some 300 million euros to the initiative to fund the development of education and training in nanotechnology.

Science museums throughout Germany are heavily involved in nanotechnology communication and a number of universities and public research centres, including MPG (Max Planck Society) and FhG (Fraunhofer Society), conduct R&D related to nanotechnology.

Germany has also established itself as the European leader in nanotechnology in terms of small to medium enterprise activity and big business enterprise. There are more than three hundred nanotechnology companies in Europe over a third are based in Germany.

The Nano-Initiative also funded the establishment of the Centres of Excellence. These Centres of Excellence, located throughout Germany, are networks of various institutes and companies in different areas of nanotechnology. Their role is to support nanotechnology research activities and to promote the industrial application of nanotechnology. Following the implementation of the BMBF sponsorship, the Centres of Excellence have continued to operate independently. In 2007, the nine German Centres for Nanotechnology joined forces to form the "Working Group of Centres of Competence of Nanotechnology in Germany" (AGeNT-D). The centres span the entire research field of nanotechnology.

Last year Germany hosted Nanotech Europe, Europe's largest nanotechnology conference and exhibition. Between 28 and 30 September 2009, the international scientific community convened at the Technische Universität Berlin to discuss cutting-edge research and industrial applications of nanotechnology. Nanotech Europe was organised by a consortium of companies, including AgeNT-D.

Research topic

The nature of nanotechnology communication aimed at German public, and its effectiveness based on the extent to which the German public are engaged and inspired.

This project focussed on nanotechnology communication principally by German science centres, in addition to various educational programs which have been designed by research centres and universities.

The research project provided the information necessary to develop a truly effective nanotechnology communication program involving interaction between Australians and Germans, which caters for individuals of all ages. The development of such a program is an opportunity for bilateral cooperation between Australia and Germany, reinforcing the aims of the Educational Development Fellowship.

Project Goals

Goal 1: To determine the most effective methods of communicating nanotechnology to the Australian and German general publics.
Goal 2: To propose an educational nanotechnology program combining scientific and cultural communication between Australians and Germans.

Personal Goals

Goal 1: To improve upon my knowledge of the German language, and to enhance my knowledge of the German culture
Goal 2: To develop a thorough knowledge of effective nanotechnology communication techniques and the existing political framework governing scientific and educational collaborative research in Germany.
Goal 3: To develop my professional skills in this field, as well as professional contacts which may assist me in obtaining sustained employment in Germany in this field at a later date

Overview of Nano Tour Germany 2010

Throughout May 2010 I visited the six institutions listed in the table below.

Institution	City	Focus
ArchiMeDes	Berlin	SciencExpress: Expedition Zukunft
Physikalish Technische Bundesanstalt	Braunschweig	Nano art, interactive media
Haus der Wissenschaft	Bremen	Nanotechnologie aus Bremen
HanseNanoTec	Hamburg	Aufbruch in neue Welten
Deutsches Museum	Munich	Zentrum Neuen Technologien
Deutsches Museum	Bonn	Mannometer: Nanometre!
Technoseum- Landesmuseum für Technik und Arbeit	Mannheim	Nano!

Table 1: Scientific and education institutions visited during May 2010

The nanotechnology programs were examined during a visit to each facility according to the communication techniques employed (such as interactive or hands-on activities, dramatised presentations and visual media such as film and nano art), as well as the intellectual level of the material presented.

The exhibitions at HanseNanoTec in Hamburg and the Deutsches Museum in Bonn were not open to the public. It was possible to make a private visit to both in order to examine the communication techniques used. Schools were able to visit the exhibitions upon booking.

Travelling Nano

Nanotechnology is communicated throughout Germany onboard the NanoTruck and SciencExpress. Both truck and train are travelling nanotech communication centres; the former funded by the BMBF, and the latter developed by the exhibition design company, ArchiMeDes.

The double-decker NanoTruck has been travelling for several years through numerous European countries with its "High-Tech from the Nanocosmos" exhibition, communicating the role of nanotechnology in medical research, environmental conservation and energy storage. Germans can make requests on-line for the NanoTruck to stop in their home town.

The 'SciencExpress' departed Berlin in April 2009 on its "Expedition Zukunft". The train made a round trip of Germany to arrive back in Berlin in November. The tour itinerary- which included sixty cities- was devised in collaboration with Germany's national rail service, the Deutsche Bahn. Visitors to SciencExpress embarked on a journey into the future which examined how human lives are being shaped by science and technology. The journey began in the first carriage with information on basic scientific research and continued in the consecutive eleven carriages with an insight into digitalisation, communication and miniaturisation.

Physikalisch-Technische Bundesanstalt (PTB), Braunschweig

The Centre of Competence for Ultra-Precise Surface Figuring (UPOB e.V.) is based at the PTB- one of its founding organisations. The centre is involved in metrology, the development of machines and machine components and sensor technology. The goal of the UPOB is to foster cooperation between industry and researchers. It organises seminars and workshops, and participates in expositions to publicise these activities. Numerous collaborative projects involving other UPOB members and the PTB have been developed, one of which is entitled 'Schuler AFM'. It is thus funded in part by the BMBF.

Schuler AFM

The measurement of the dimensions of micro and nano structures is an integral aspect of nanotechnology due to the fact that physical and chemical properties of such structures are often determined by their size. Direct analysis of nanostructures cannot be achieved with light microscopy, as the structures are smaller than the optical diffraction limit. Instead, the atomic force microscope (AFM) can be used. The AFM uses nanometre-fine cantilever tips to raster-scan the surface of the material line by line. The information is then stored in the computer as a data matrix and finally used to generate a three-dimensional image.

The PTB has developed a project entitled 'Schuler AFM', which places AFMs at the disposition of students. The aim of the project was to make modern nanotechnology accessible to school children. The AFMs are developed and constructed at the PTB with the support of the Centre of Competence for ultra-precise surface figuring (CC UPOB e.V.) and the Working Group of Centres of Competence of Nanotechnology in Germany (AGeNT-D).

The PTB boasts considerable experience in the development of AFMs for metrological purposes. The 'Schuler AFM' has a very clear and simple structure, and is therefore well-suited to educational purposes. School children can even assemble the microscopes themselves. In doing so, they

acquire practical experience in the fields of precision mechanics, electronics and computer programming. Development of this interdisciplinary knowledge renders nano microscopy extremely worthwhile as an educational vehicle.

Nano Art

'We especially need imagination in science. It is not all mathematics, nor all logic, but is somewhat beauty and poetry' (Maria Mitchell, American astronomer, 1818-1889).

Art-science collaboration encourages artists to explore the possibilities of the technologies of science and encourages scientists to fulfill their curiosities despite the constraints associated with scientific research. Nano art is a medium which holds enormous potential for the communication of nanotechnology. As a visual medium it immediately engages the viewer, and provokes an instant response. Displaying scientific data artistically is a way of making scientific concepts accessible to society at large, including people of non-scientific backgrounds who might otherwise be excluded from such information.

'The examination of nanostructures reveals fantastic images that transport us into fascinating worlds that are full of secrets...In a mysterious way, the motifs are similar to macroworld objects' (Expedition Zukunft, ArchiMeDes, November 2009).

It is this uncanny likeness that often exists between nano structures and structures in the macroworld that allows the viewer to identify with the art work, and therefore gain an appreciation for the nanostructure.

Nano art was featured by only two of the six institutions listed in Table 1, namely SciencExpress, by ArchiMeDes in Berlin, and PTB, Braunschweig.

Dr Hans Danzebrink at the PTB has produced various nano artworks, several of which have been featured in the Images From Science Exhibition. This exhibition features appealing visualisations of seldom-seen events and draws entries from the broadest range of scientific disciplines, including geology, medicine, biology, engineering, oceanography and physics.

In 2008, the exhibition featured Danzebrink's artwork 'Aesthetic Imperfections'.

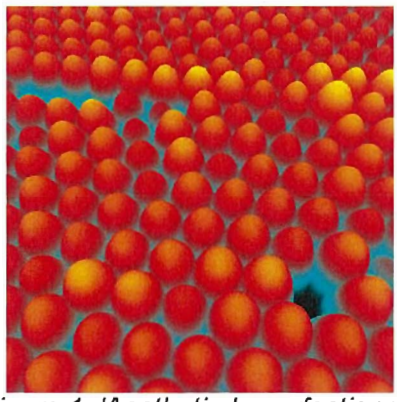

Figure 1: 'Aesthetic Imperfections'
Dr Hans Danzebrink

Vibrant orange and turquoise instantly captures the viewer's attention. Row upon row of orange nanospheres are depicted: a vision of little orange eggs, each modelling itself on the form of its neighbour. And then, suddenly: an egg is missing. In its place is a black crevice, shaped as if the unassuming nanosphere has been sucked out from underneath itself. A glaring omission, blemishing the vision of almost-perfect order.

The atomic force photomicrograph reveals dislocations in a photonic crystal arrangement of polystyrene nanospheres. Without the vivid colours generated by computer software, these transparent structures are instead defined by their topography, geometry and symmetry. It is these characteristics which give rise to the optical effects in the material, visible to the human eye. The viewer is invited to ponder the interplay between different faces of the same object- the colourless world of the nano scale, and the iridescent play of colours on the macro scale.

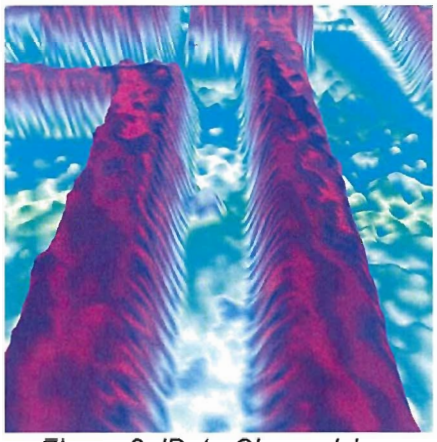

Figure 2: 'Data Channels'
Dr Hans Danzebrink

"Data Channels", also by Dr Danzebrink, was selected along with "Aesthetic Imperfections" from several hundred entries to be featured in Images From Science 2008. The atomic force photomicrograph is a circuit-level image of a computer chip magnified 35 000 times. The data is depicted as vibrant turquoise "water" flowing through the channels of the microprocessor.

Interactive Media

I).'Nanowelten', developed at the PTB

The interactive experience 'Nanowelten' was developed at the PTB and displayed at the Technoseum Mannheim as part of its 'Nano!' exhibition.

The program allows the individual to enter and discover the surfaces of nanomaterials in a fully interactive way. The 'surface worlds'- three-dimensional, interactive scenes- are actual representations of nanomaterials, as they are created from real measurement data. By using different interfaces (such as Nintendo's Wiimote controller and a video camera based body position detection system) the user is able to control their journey across the surface. In addition, it is possible to add physical information and effects to the representation of the surface data. The system is thus able to demonstrate the influence of environmental vibrations on the nano world.

The visualisation is aimed at audiences of all ages. The inclusion of computer game technology in the described project is especially engaging for children and teenagers. The concept of just how small one nanometre is, is difficult to grasp. However 'Nanowelten' provides the opportunity to walk across a computer chip or dodge silicon atoms, which successfully gives the user a 'feel' for the nanoscale. The fast-paced flying motion increases the 'entertainment factor' of the visualisation. Dynamic colours are used to achieve visual impact.

'Nanowelten' creators Dr Hans Danzebrink, Sebastian Strube and Dr Gabor Molnar at the PTB describe/articulate their intention as being: 'to provide people of all backgrounds with access to nanotechnology, and to attract children and teenagers to the domain of science'. The nature of the visualisation- "walking" over the data and controlling the journey using different interfaces- is an original approach to illustrating the nanoscale.

Figure 3: The user's head movements control the journey through the nanoworld

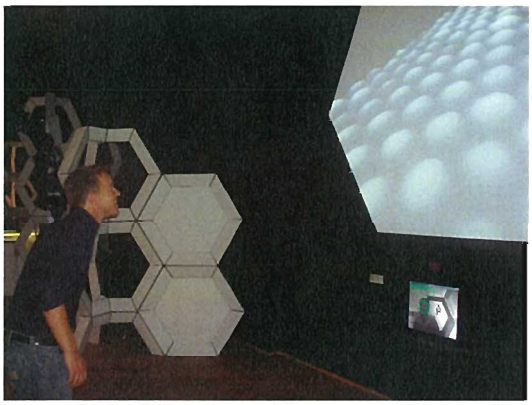

Figure 4: A visitor travelling over silicon atoms

II). NanoReisen, developed by the VDI Technologiezentrum

Another example of an interactive game program developed to communicate nanotechnology is Nanoreisen.de. This website, the development of which was funded by the BMBF, allows the user to embark on a virtual journey into the Nanocosmos. The website offers "adventures beyond the decimal". Visitors to the website can "check in" and then choose between three destinations- the human body, via the "Ego-Trip Route", the laptop computer, via the "Bit-Land Route", or the automobile, via the "Bright Spot Route".

The virtual suitcase is packed with equipment necessary for a journey into the nanocosmos- a scaling system, offering comparisons between the macro, micro and nano worlds, and a route planner, which depicts features of each destination. Using the planner on the Ego-Trip Route, the traveller becomes progressively smaller and smaller and can make stops at different areas of the human body. A journey can begin in "the tropical hair forest" and then progress on to "rush hour in the capillary system" before "snorkelling in the gene pool".

At each of the fifteen stops on the Ego-Trip Route there are in-depth explanations of their various features. For example, by clicking on a scanning electron microscope image of a human hair, the user discovers that follicles are created in the sixth week of pregnancy and that a human being can grow a maximum of 5 million hairs. Travelling through the epidermis and into a blood vessel of 0.1 millimetres in diameter, the scale bar in the travel guide informs the user that the difference between 0.1 millimetres and one metre is proportional to the difference between the width of the

Rhine River Bridge and the diameter of the earth.

The Ego-Trip journey comes to an end after being shrunk to the size of a femtometre (at which point the user is informed that one femtometre to one metre is like the diameter of a protein molecule to the diameter of the earth). This final stage explains the twelve fundamental particles of our cosmos, as well as the concept of dark matter.

Before re-entering the macro world, travellers are invited to send a personalised e-card to friends proclaiming, "Greetings From the Nanocosmos".

Deutsches Museum, Munich

The Deutsches Museum in Munich is the world's largest museum of technology and science, and houses a permanent core exhibition on nano and biotechnology with topical changing exhibitions and laboratories. The exhibition "Everyday Life with Nanoproducts" was opened in 2007 and features over seventy products based on nanotechnology that are already commercially available, including coatings, clothing, kitchenware, domestic products and nanoelectronics.

The Deutches Museum also heads the "NanoToTouch" project. The European Commission-funded project involves a fully-functional Scanning Probe Microscopy laboratory. Visitors have the opportunity to interact with nanoscientists who demonstrate various applications of nanotechnology.

Nanotechnology Is All Around Us

The exhibitions at the Deutsches Museums in Munich and Bonn, at HanseNanoTec in Hamburg and at Technoseum in Mannheim demonstrated the presence of nano in products available commercially, thus increasing the visitor's awareness of the presence of this technology in their everyday life.

Figure 5: Nano Products Shopping Station, Technoseum, Mannheim

Nano!, at the Technoseum, featured an interactive shopping expedition, which allowed the visitor to 'buy' common products that had been developed using nanotechnology. These products included tomato sauce containing nanoparticles and sunscreen containing nanoparticulate titanium dioxide.

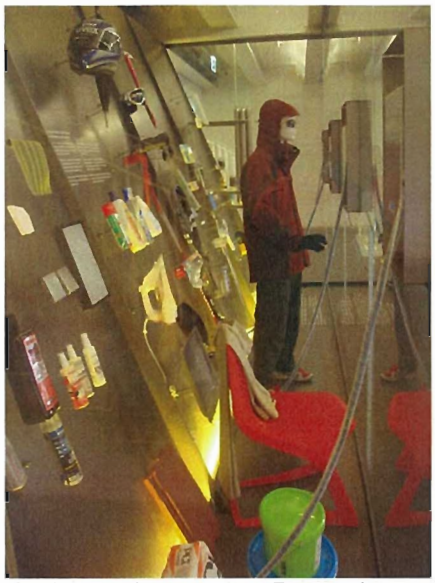

Figure 6: Nano products on show at the Deutsches Museum, Munich

An impressive nano effect, known as the Lotus Effect, also featured at the Deutsches Museums in Munich and Bonn, HanseNanoTec in Hamburg and the Technoseum in Mannheim. At the Deutsches Museum in Munich and the Technoseum, Mannheim, the presence of the Lotus Effect in nature was explained, and its application in nano products then demonstrated. This initial explanation of the Lotus Effect in nature increases the visitor's awareness that nanotechnology is indeed all around us.

The lotus leaf is highly water repellent due to its nanoscopic surface structure. When a water droplet comes into contact with its surface, the adhesion forces between the droplet and surface are reduced, thus allowing the water droplet to retain its spherical shape. This results in reduced wetting and a self-cleaning process occurs.

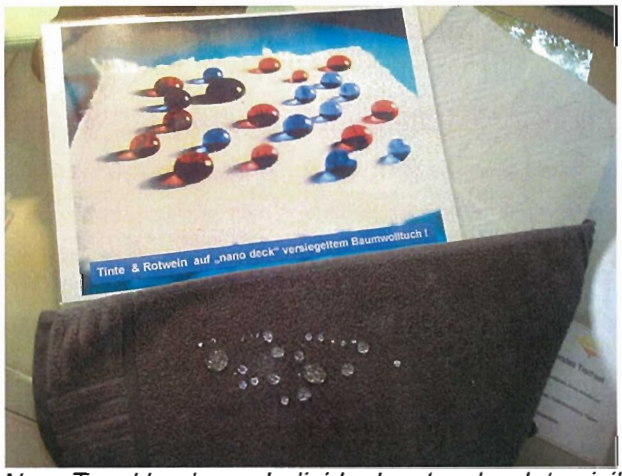

Figure 7: HanseNanoTec, Hamburg- Individual water droplets visible on the surface of a towel, developed using the lotus effect

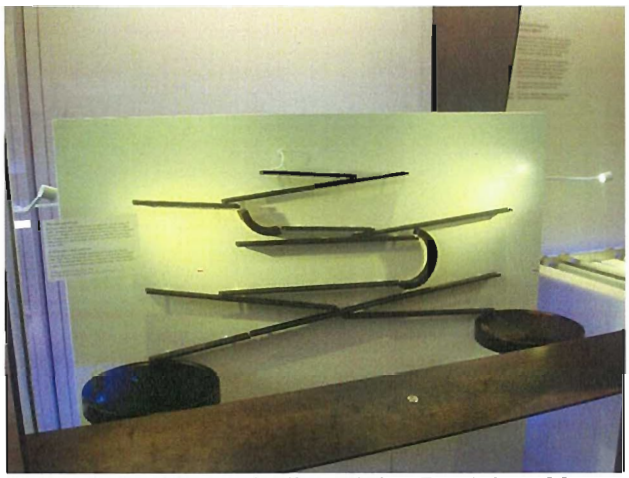

Figure 8: The Lotus Effect demonstration at the Deutches Museum, Munich- A water droplet is released and 'rolls' down the entire length of the platform

The impressiveness of this demonstration succeeds in captivating the visitor's attention and its visual impact is especially successful in engaging young children.

Nanoparticulate silicon dioxide is also visually engaging due to its unusual physical properties. Samples of the substance were exhibited at the Deutsches Museums in Munich and Bonn, at HanseNanoTec in Hamburg and at Technoseum in Mannheim.

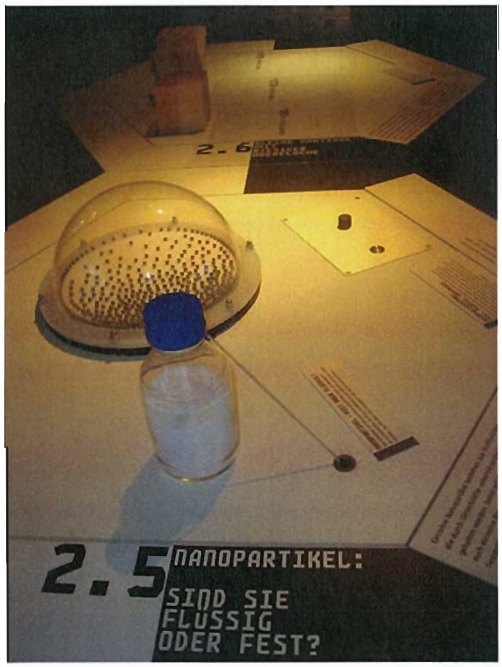

Figure 9: Nanoparticulate silicon dioxide on show at the Technoseum, Mannheim

Visitors to the Technoseum in Mannheim were able to pick up the bottle of nanoparticulate silicon dioxide, pictured above, and shake it. Upon shaking, it appears that the bottle holds a liquid. This is due to the repulsive forces between silicon dioxide molecules- the particles move past each other as opposed to being attracted to each other.

The Zentrum Neuen Technologien at the Deutsches Museum, Munich, boasts an open research laboratory. This provides visitors with the unusual opportunity to observe professional scientists carrying out current research and performing tasks such as the measurement of nanostructures using atomic force and scanning tunnelling microscopes. In addition, substances such as nanoparticulate silicon dioxide and ferrofluids are on show, and their properties are demonstrated

by the scientists to interested visitors.

The open research laboratory succeeds in breaking down the barrier between scientists and the general public. The scientists stationed at the laboratory happily answer questions and explain the aims of their research and the functioning of the instruments. The experience provides the visitor with a realistic understanding of how nanotechnology research is carried out. This visual experience allows the individual to more fully engage with other aspects of the exhibition, as they have a deeper understanding of how the information presented to them is obtained.

Figure 10 and 11: The open research lab at the Deutsches Museum, Munich: Nano effects and research on show

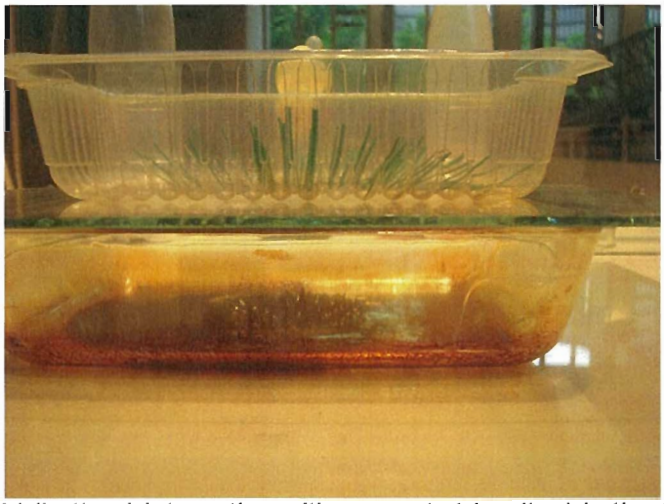

Figure 12: Ferrofluid (bottom) interacting with magnet strips (top) in the Open Research Laboratory, Deutsches Museum, Munich

The ferrofluid demonstration at the Deutsches Museum, pictured above, succeeded in attracting and impressing visitors of all ages to the Open Research Laboratory. Ferrofluids are colloidal suspensions of nanoparticles of an iron-containing compound such as magnetite. A ferrofluid becomes magnetised in the presence of a magnetic field, however it retains its liquid state due to its nanoparticulate composition. When the magnetic field is changed, the fluid moves and ferrofluid 'structures', like the one above, can be created.

Broaching of Nano Risks

The risks associated with nanotechnology emerged as one of the main focusses of nano communication in Germany. Nano risks were thoroughly covered by all exhibitions listed in Table 1, thus encouraging a cautious approach to nanotechnology. Questions posed by members of the public at both the Haus der Wissenschaft and the Deutsches Museum (Munich) were also related to nano risks.

Both the Deutsches Museum (Munich) and the Technoseum provided interactive survey stations at the final stage of the exhibitions. This allowed the visitor to express their opinion on the possible outcomes of nanotechnology, as well as providing them with food for thought as they left the exhibition.

At the Technoseum, after having answered the series of questions relating to nanotechnology, the participant was presented with graphs showing how their answers compared with those of previous visitors, and the general German public (data taken from the BfR survey, 'Wahrnehmung der Nanotechnologie in der Bevölkerung, May 2008). The survey included questions such as:

'Which of the following products would you use, if you knew they contained nanoparticles?'
a). Clothing b). Food products c). Cosmetics d). Cleaning products

'Which of the following statements do you agree with the most?'
a). I don't have any interest at all in modern technologies, including nanotechnology
b). Nanotechnologies should be developed, but possible associated risks should always be considered
c). I agree that nanotechnologies pose risks for human health and the environment, but I'm not too worried about it

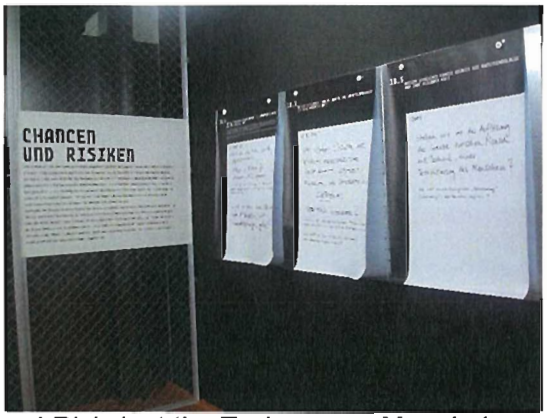

Figure 13 and 14: Final station 'Chances and Risks', at the Techoseum, Mannheim

The final station of 'Nano!' at the Technoseum also showcased four professionals from different fields- the philosopher Professor Armin Grunwald, the Director of the nanotechnology company, NanoGate, Mr Michael Jung, scientist Professor Harald Krug and member of the Green movement, Patricia Cameron. At this station, the visitor was able to choose from videos of interviews with each of the professionals, relating to the following topics: Chances, Risks, Ethical Questions and Nano in Society. The aim of this final station was to provide the visitor with enough information to form their own opinion on nanotechnology and its future.

Figure 15: Video interview with Professor Harald Krug at Nano!, Technoseum

The final station of the exhibition at the Deutsches Museum (Munich) also encouraged the visitor to reflect on the future of nano, through interaction with the 'Nano Oracle'. The visitor was able to choose a theme from a selection including, 'Clean Energy', 'A Child Made to Measure', 'Robots' and 'Forever Young'. If the visitor were to choose, for example, 'Forever Young', the Nano Oracle would postulate two different futures; one which highlighted the advantages of retaining a youthful appearance, and one which highlighted its disadvantages. The visitor could then decide which future they found to be more favourable.

Summary

This research project established that to effectively communicate nanotechnology to the public, it is essential to first convey the concept of the nano scale. That is, the individual should be given a 'feel' for just how small one nanometre is. This can be effectively achieved by presenting the individual with an image of a familiar macroscopic object, then zooming into this image, eventually reaching the nanometre level. Such a 'journey' should be experienced at the entry to the exhibition. This was successfully executed at the Technoseum, Mannheim, where visitors entered an elevator. The individual was given the impression of travelling 'down' into the nanoworld.

It is essential to remember that nanotechnological concepts are foreign to many members of the general public. Employing a variety of media is a way of rendering this scientific information accessible to a range of audiences, including people from non-scientific backgrounds. An interactive installation such as 'Nanowelten', developed at the PTB Braunschweig, is especially engaging for children. Dynamic colours and motion scenes were used in this installation to achieve visual impact. The individual is given the impression that they are "flying through" the data, heightening the experience of journeying into the nanoworld.

It was observed that nano art was not used extensively in nanotechnology communication in Germany. Artworks were featured only on the SciencExpress and at the PTB Braunschweig, as part of the Images of Science Exhibition. Nano art is a medium which can be used to achieve visual impact. It would aid in engaging people of non-scientific backgrounds in nanotechnology, and therefore should be widely used in nanotechnology exhibitions.

Enhancement of future Australian-German business and cultural relations

The Science and Technology Agreement signed by Australia and the European Union in 1994, and the bilateral agreement signed by Australia and Germany in 1974, clearly indicate the desire of both countries to foster international connections. The research carried out into nanotechnology communication provides opportunities for collaboration between Australia and Germany, enhancing bilateral relations.

An educational nanotechnology program would encourage cooperation between Australian and German science museums. For example, the program may be adopted by both the Deutsches Museum, in Munich, and Questacon, in Canberra. This connection may then lead to the exchange of other exhibitions.

Interaction between Australians and Germans as part of an educational nanotechnology program would combine scientific communication with cultural communication. Possible elements of the program include a video presentation, subtitled, showcasing Australians and Germans from different walks of life and their involvement or interest in nanotechnology. Case studies may include school-age science students from both countries, university students conducting research in nanotechnology, the directors of companies using nanotechnology and members of the German and Australian public, possessing little or no prior knowledge of nanotechnology. The program would also feature nano artwork created by both Australians and Germans, as well as nanotechnology R&D involving bilateral cooperation.

The project provides pathways to further studies, thereby enhancing Australia's and Germany's research landscapes. An example of a further study is a comparison of the extent to which certain aspects of an educational nanotechnology program engage the Australian public, with the extent to which these same aspects engage the German public. The findings of such research may provide insight into cultural parallels and differences.

Intensive German Course at the Goethe Institut, Berlin

I debarked from Perth on March 5, 2010, waving goodbye to blue skies and deliciously warm Western Australian summer temperatures. I was greeted upon my arrival in Germany by one of the coldest, and longest, winters that Germany had ever experienced. Adjusting to this new climate was difficult, I must say, however I was ecstatic to have finally arrived in my 'Ziel'- the sprawling, vibrant, eclectic city of Berlin. Three days later I began an intensive German language course at the Goethe Institute. Situated very close to Alexander Platz in the quartier Berlin Mitte, the school is surrounded by restaurants, bars and shopping strips. Almost every lesson was followed by the difficult decision of where to enjoy lunch. Thanks to Berlin's 'multiculti' population, my classmates and I enjoyed Mexican, Italian, Spanish, Japanese, Thai, Vietnamese and Korean traditional cuisine, and of course, the occasional German sausage. Cooking for myself was also very enjoyable, thanks to the enormous choice of organic produce available in every supermarket.

Figure 16: The Mediathek at Goethe Institut Berlin

Figure 17: The busy quartier Berlin Mitte

Figure 18: Our favourite cafe, conveniently situated directly opposite Goethe

After lunch I most often returned to school to take part in the extra-curricular cultural program. Over the two months I was escorted through the Reichstag, the Pergamon Museum and the Deutsches Historisches Museum, and attended evening lectures on the Weimar Republik, Nationalsozialismus, forbidden art during the Third Reich, the Deutsches Demokratiches Republik and even current construction projects in the ever-changing city of Berlin. City visits included a walk along the Berlin wall and a tour of the old Jewish quarter, both guided by Berliners and experts in the fields. A definite highlight was visiting the Deutsche Welle Studios, Germany's international television channel. I was rather star-struck when I crossed paths with the news readers who are broadcast over SBS Australian television.

I revelled in the opportunity to immerse myself in the German language. Our lessons at the Goethe Institut were always refreshingly varied, thanks to our wonderful teacher, Sonja Konrath. She introduced us to German literature, German film, German art and German music, and somehow managed to fit in plenty of German grammar as well. She chose both classic and modern examples of novels, poems, paintings and songs, which gave us a wonderful insight into the culture from the perspective of a German person. At the end of the two months, which went by extremely quickly, we all enjoyed traditional cuisine at Sonja's favourite German restaurant.

In order to encourage our confidence in speaking German, Sonja invited each student to give a short presentation in front of the class on a topic of our choice. I was keen to share the Australian culture with my classmates, and so decided to speak on the topic of the Stolen Generation. Being an audience member was also a privilege, as many of my classmates spoke about their own country and culture.