MAX PLANCK News

Plunge into the world of science: With this Science Tunnel poster, the Japanese future museum invites its visitors to take an excursion through the research of the 78 institutes of the Max Planck Society and its partners.

PHOTO: ARCHIMEDES/MIRAIKAN

A Walk through Unknown Worlds

Interactively experience German cutting-edge research in Japan – a walk through the new Science Tunnel of the Max Planck Society makes this possible. On September 15th, the multimedia exhibition was opened at the National Museum for Emerging Science and Innovation (Miraikan) in Tokyo/Japan by Peter Gruss, President of the Max Planck Society. Until November 17, 2005, visitors can take a fascinating trip through current scientific discoveries.

Over a period of four years, from 2000 to 2004, the first Science Tunnel successfully presented cutting-edge research carried out by the Max Planck Society worldwide. After a complete reworking, the new interactive multimedia exhibition premiered in Ludwigshafen, Germany from April 29 to July 17, 2005. After a six-week sea voyage and ten days of set-up time, the exhibition can now be seen in the futuristic National Museum for Emerging Science and Innovation in Tokyo – an important highpoint in the "German Year in Japan."

Mamoru Mohri, the first Japanese astronaut and Director of the Japanese future museum MIRAIKAN, is looking forward to the German exhibition with great anticipation. "I am proud that our museum is hosting the premiere of the Science Tunnel in Japan. This multimedia exhibition presents top research from Germany and I am excited to see what new contacts this will prompt between Japan and Germany."

In the Science Tunnel, visitors can experience science close-up and be fascinated by images of microscopic worlds and distant galaxies. In this way, visitors are given a glimpse into the boundaries between space and time and enter the mysterious worlds and technologies of tomorrow – nanotechnology, biotechnology and neuroelectronics. The Science Tunnel offers a view into the universe of the mind and reveals how our bodies direct its billions of cells and how the brain creates music. Visitors can observe the dance of atoms and molecules, discover the roots of human culture in the tools of our animal relatives, fight as a virus for the invasion of the body using a computer and race with a bicycle at the speed of light through the German city of Tübingen.

"The Science Tunnel offers a view into the newest research, into subject matter that is making news today and will soon influence our everyday lives," emphasizes Peter Gruss, President of the Max Planck Society. "In particular, we want to show Japan's young people that research in Germany is at the vanguard internationally and offers lots of opportunities." ●

www
Website of the new Science Tunnel
www.sciencetunnel.de

WENDELSTEIN 7-X FUSION EXPERIMENT

Six Years of Nuts and Bolts

After years of calculation, preparation and component manufacturing, the Wendelstein 7-X project is now entering a new phase. Work has at last begun at the Greifswald Branch of the Max Planck Institute of Plasma Physics (IPP) on assembling this fusion plant – the world's largest stellarator, construction of which will consume more than a thousand tons of materials.

It sounds a little like sewing, but in this case the word 'threading' has a different meaning: the term is used by experts to describe the installation of the magnetic coils that are threaded onto the plasma vessel, the central element of Wendelstein 7-X. This marks the start of the assembly of the large-scale experimental system, a process that will take around six years.

The aim of fusion research is to extract energy from the fusion of atomic nuclei, following the example set by the Sun. In order to ignite the fusion fire, the hydrogen plasma fuel must be enclosed within magnetic fields and heated to temperatures in excess of 100 million degrees in a power plant that is yet to come. Once completed, Wendelstein 7-X will be the world's largest stellarator-type fusion plant, the function of which is to investigate the suitability of this design for power station use. The discharges last up to 30 minutes and are regarded as a key prerequisite for continuous operation.

A wreath of 50 superconductive magnetic coils, some three and a half meters in height, forms the core of the plant. Their bizarre shapes are the result of sophisticated calculation and optimization: they are intended to provide a particularly stable, thermal insulating magnetic cage for the plasma. In order to exert an influence on the magnetic field, the stellarator coils are subordinated to a second set of 20 flat and likewise superconductive coils. A massive annular supporting structure holds all of the coils in precise position, despite the high magnetic forces.

Surrounding the entire wreath of coils is a thermal insulating outer shell some 16 meters in diameter, the cryostat. A cooling system will subsequently provide 5,000 watts of helium cooling to reduce the magnets and their supports to a superconductive temperature. Within the ring of coils is the plasma vessel, the unconventional shape of which is adapted to the serpentine plasma tube. The plasma can later be observed and heated through a total of 299 holes. The same number of well-insulated nozzles passing between the coils connect these apertures with the outer wall of the cryostat. The installation as a whole is comprised of five virtually identical modules that will each be pre-assembled before being set up in a ring in the experimentation hall.

Work on assembling the first half-module began early in April. The first part of the plasma vessel was lifted into the pre-assembly position and a special grab used to carefully thread the first magnetic coils onto the vessel segment with only millimeter-wide clearances. Only then can the second sector of the plasma vessel be welded into place and the thermal insulation completed around the seam.

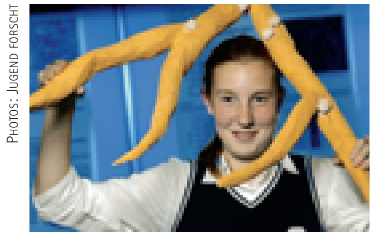
This super-insulation separates the intensely cooled magnetic coils from their hot surroundings. Four more stellarator coils and two of the supplementary coils are threaded from front and back onto the vessel segment and positioned in exact geometric alignment on their own erection supports. Finally, a segment of the carrier ring is pushed against the coils and bolted down. After many other additional tasks have been completed and many control measurements taken, the first half-module will then be ready.

In parallel with the erection of the machine itself, the microwave system will also be assembled to heat the plasma. Work will also proceed on installing the electrical energy and cooling supplies, followed by the machine control systems, and finally, the measuring equipment tasked with diagnosing the behavior of the plasma. Assembly manager Lutz Wegener hopes that component supplies from industry will arrive on time and that the construction schedule was correctly calculated. "If so, Wendelstein 7-X should be operational in about six years' time." ●

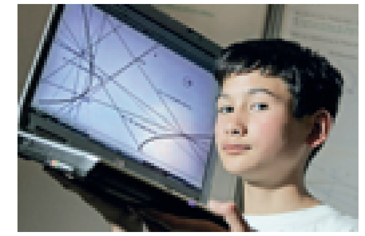
PHOTO: IPP

Suspended from a rotating frame, the first of the stellarator's 50 magnetic coils is threaded onto a segment of the plasma vessel. The Wendelstein 7-X fusion plant is expected to be operational in six years' time.

PHOTOS: JUGEND FORSCHT

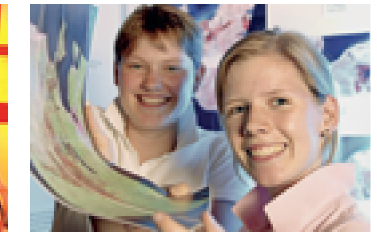


Susanne Kreßner



Philipp Hülsdunk

Markus Helmer und Matthias Müller



Birte K. Marquardt und Jannike Pasche

JUGEND FORSCHT

Beans and Helicopters

The results are in for Germany's 40th nationwide junior research contest "Jugend forscht." Some 8,945 young scientists entered this year's anniversary contest – more than ever before. Of those, 218 – representing 120 projects – went on to qualify for the national round. At the end of May, Horst Köhler, President of the Federal Republic of Germany, paid tribute to the winners in Dortmund. Once again, the Max Planck Society donated the third prizes in the categories Biology, Geoscience and Space Research, Mathematics/Information Technology and Physics: Susanne Kreßner, Birte Katharina Marquardt together with Jannike Pasche, Philipp Hülsdunk, and Markus Helmer together with Matthias Müller each received the 500 euro prize.

Legumes, such as clover and soybeans, form nodules on their roots in which bacteria live. These have the ability to convert the nitrogen in the air into a form that serves directly as a nutrient for the plant. In return, the bacteria receive a supply of carbohydrates. This symbiotic relationship involving the fixing of nitrogen can be noticeably enhanced by the application of mineral fertilizers, as Susanne Kressner from the Carl-Friedrich-Gauss-Gymnasium in Frankfurt an der Oder discovered in her field trial with soybeans. In her experiment, the 18-year-old student was able to significantly increase plant growth and yield. This could offer an economic means by which developing countries could boost both their soy harvest and the nitrogen content of the soil for subsequent crops. The biology prizewinner also established that sandy soils with low nutrient levels are particularly well suited to soy cultivation.

The ecology of the Aral Sea system in Asia was the subject chosen by Birte Katharina Marquardt (18) and Jannike Pasche (18) in the category Geoscience and Space. Since 1960, the sea's area has dwindled dramatically, and many species of fish have already died out. According to forecasts, in a few years' time it will have totally disappeared. To the two young scientists from the Gesamtschule Walddörfer in Hamburg, this assumption seemed too general, and their enthusiasm for research was aroused. First, they digitized satellite photographs of the Small Aral Sea, enabling them to detect quantitative changes in the coastline, and thus also in the water area. Thereafter, they looked for individual phenomena in order to test the desiccation forecast.

The photos were of such high resolution that even smaller changes could be detected – leading the two students to the conclusion that the Small Aral Sea will not dry out entirely, but will stagnate at a lower water level.

How do you plan a helicopter base so as to ensure that the maximum distance to its deployment locations is as short as possible? That is the mathematical problem Philipp Hülsdunk of the Taunusschule, Königstein, tackled in the Mathematics/Information Technology category. The 15-year-old's findings could help minimize future flight times and distances. He analyzed the relationships between points and distances in triangles and came up with a series of generally applicable geometric principles.

What happens if you put an ice cube into a container of oil? It either remains on the surface, or it sinks – its behavior is seemingly unpredictable. If the densities of oil and ice are very similar, a drop of melted water on the ice cube can cause it, quite unexpectedly, to oscillate up and down. If the ice cube is so light that it floats on the surface, it will always remain at the edge of the vessel. Markus Helmer (20) of the Student Research Center in Bad Saulgau and Matthias Müller (20) of the Center for Psychiatry in Zwiefalten studied this phenomenon in the project they submitted in the Physics category, and worked out the effects that might occur. For the seemingly chaotic behavior of the ice cube, the two young researchers were able to postulate criteria that allow some degree of predictability – but a bit of uncertainty still lingers. ●

MEDICAL RESEARCH

Ludolf von Krehl's Vision

In the 1920s, the renowned physician and director of the University Clinic in Heidelberg, Ludolf von Krehl, had a vision: fundamental medical research, he believed, would make great strides if scientists in the fields of pathology and physiology were to collaborate with physicists and chemists as well. So confident was von Krehl that he succeeded in convincing the Kaiser Wilhelm Society. As a result, the Kaiser Wilhelm Institute for Medical Research was established – exactly 75 years ago. Since then, the Institute has been home to more Nobel Prize winners than any other Kaiser Wilhelm or Max Planck Institute.

Today, the concept of interdisciplinary research is widespread, but at the time it was a minor revolution. There was only one other comparable institution worldwide – the Rockefeller Institute in New York. Krehl found a supporter of his ideas in the person of Adolf von Harnack, the first President of the Kaiser Wilhelm Society. Together they managed to secure three vital figures as founding directors, namely the physicist Karl Hausser, the physiologist Otto Meyerhof and the talented young chemist Richard Kuhn. Ludolf von Krehl himself became head of pathology. Architect Hans Freese chose a site by the Neckar river, surrounded by orchards and grazing sheep, and proceeded to design a visionary building that embodied many of the ideas of the Bauhaus movement and did ample justice to Krehl's visionary approach.

A short time later, the University Surgical Clinic was erected close by – and the die was cast for a scientific campus. Today, the nearby buildings include the university's Molecular Biology Research Center and the German Cancer Research Center. Located just a little further away is the European Molecular Biology Laboratory (EMBL). At the celebration to mark the Institute's anniversary, Max Planck Society President Peter Gruss praised the cooperation between these molecular biology institutions as a fine example of how centers of excellence can develop around a Max Planck Institute.

"We are indeed a fortunate Institute," declared Director Winfried Denk, referring to the Heidelberg establishment whose business affairs are currently in his charge. Denk and his colleagues Ilme Schlichting, Peter Seeburg and Nobel Prize winner Bert Sakmann together form the quartet of Directors who head a program concerned primarily with researching the function of the brain. The scientists, who study the flow of information at molecular level in the brain and analyze the biochemical activity, describe their work as "watching the brain think." In a guest lecture at the anniversary celebration, one of the Institute's external scientific members, Amiram Grinvald from the Weizmann Institute in Israel, described his own neurophysiological research.

MPS President Gruss sketched the path that the Institute has followed to the present day – a necessarily sinuous one, reflecting the appointment of new directors at intervals of a decade or two, each of whom has shifted the focus of research. Nor did Gruss overlook the National Socialist era, during which, in 1937, the founder Ludolf von Krehl died. A year later, under Nazi pressure, Otto Meyerhof was forced to leave

The Kaiser Wilhelm Society built its Institute for Medical Research on the banks of the Neckar River at the end of the 1920s. In the meantime, a number of other institutions devoted to molecular biology have settled in the immediate vicinity, contributing to Heidelberg's high standing in this field.

the Institute and flee the country. The two remaining Directors soon committed themselves to research in support of the war effort, with Walter Bothe working on the controlled chain reaction. Had the work been successful, it would have opened the way for the National Socialists not only to manufacture a nuclear reactor, but possibly also to build an atom bomb.

Noting the findings of the commission studying the Kaiser Wilhelm Society under National Socialism, Peter Gruss went on to describe how in the 1940s Richard Kuhn concentrated on researching nerve gases. One of the products of his work was Soman – one of the most toxic nerve gases ever discovered, but never used. Kuhn also served as divisional head of organic chemistry in the 'Reichsforschungsrat', and used this influential position to award funding for projects dealing with chemical means of mass extermination.

Such complicity with those in power during the Third Reich must not be swept under the carpet, insisted Gruss, who called on his audience to acknowledge this part of the Institute's history and to learn from it for the future – a request that was well received. This was evidenced also by a small exhibition assembled by members of the Institute staff. Original documents confirmed the involvement of Kaiser Wilhelm Society scientists in the Nazi system, while leaving visitors room to draw their own conclusions.

Annette Vogt, a member of staff at the Max Planck Institute for the History of Science, received loud applause for her suggestion that a memorial plaque be installed at the Institute bearing the names of those expelled by the Nazis – 17 Jewish and foreign scientists and scientific staff.

PHOTOS: MPI FOR MEDICAL RESEARCH

Jointly proud of the excellent work of the Max Planck Institute for Medical Research: Michael Sieber, Secretary of State at the Baden-Württemberg Ministry of Science, Peter Comba, Pro-rector of the University of Heidelberg, Max Planck President Peter Gruss and the Mayor of Heidelberg Beate Weber (from left).

In his address, President Gruss also paid tribute to the glories of the Institute. The verdicts "outstanding" and "world-leading" are regularly to be found in the reports of the evaulation committee – which is only logical, given the number of Nobel Prize winners who have worked at the Institute. Meyerhof was already a Nobel laureate (1922) when he joined the Institute, while Kuhn (1938), Bothe (1954) and Sakmann (1991) became prizewinners during their time with the Max Planck Society – although Kuhn, like Butenandt a year later, was forced by pressure from Hitler to decline the award and did not receive it until after the War. Rudolf Mössbauer was awarded a Nobel Prize in 1961 for work carried out during the 1950s when he was studying for his doctorate at the Institute. And no less than four of Meyerhof's assistants who worked with him in Heidelberg in the 1930s later went on to win Nobel Prizes.

In the early days of the Institute the main focus was on cell metabolism and the influence of factors impacting on the cell from outside – in the case of Richard Kuhn these, for example, included vitamins, while Otto Meyerhof studied metabolites and Karl Hausser concentrated on UV light. After the War it was a matter of adapting to changed conditions. After 1945, Kuhn was allowed to return to work immediately; however, at the behest of the Americans, Bothe was no longer permitted to work on nuclear physics; he did not return to the Max Planck Institute until 1953, after a period spent at Heidelberg University.

The first new appointment to the Institute was made in 1954: Hans Hermann Weber, who had been Meyerhof's assistant and maintained contact with him after he emigrated, came to study muscle physiology. Numerous international contacts supported the Institute's work. Then in the 1960s came a change of direction. The Physics Department became a separate Max Planck Institute specializing in nuclear physics under the leadership of Wolfgang Gentner. Since Kuhn and Weber retired almost simultaneously only a short time later, and since the Institute was due to expand to include five departments, five new Directors were appointed within just three years: Wilhelm Hasselbach, Hartmut Hoffmann-Berling, Karl Hausser – son of the founder – Theodor Wieland and Kenneth Holmes.

How can electron spin resonance and synchrotron radiation be harnessed for use in molecular biology? How do viruses reproduce, and how are ions transported through cell membranes? These were some of the new questions being posed. Hasselbach discovered the first ATP-controlled membrane pump in muscles, while Hoffmann-Berling found the first example of a DNA helicase enzyme which unrolls the double helix – a prerequisite for DNA synthesis or repair.

In 1974 the Institute expanded further with the addition of a sixth department: Heinz Staab followed the tradition of Richard Kuhn in the field of organic chemistry, as well as serving as President of the Max Planck Society from 1984 to 1990. Staab, who in addition to his duties as a Max Planck Director was also dean of his faculty at the University of Heidelberg, was not the only Director to forge close bonds between the Institute and the university. The other Scientific Members were also active in university circles – and without them the EMBL and the Cancer Research Center would have been unthinkable. Holmes, for his part, established relations with DESY, the German synchrotron in Hamburg.

From 1989 onwards, the Institute saw a further generation shift that led to the present four-member directorate. Eckard Mandelkow as a Scientific Member without a Directorship completes the senior management team – as a physicist, he heads the Max Planck research group on structural molecular biology at DESY. And the door is starting to open to further changes: three of these five leading figures are due to retire shortly.

Pinboard

BÄRBEL, ALEXA AND DAISY: – These names are important to Eduard Arzt, Stanislav Gorb, Huajian Gao and Ralf Spolenak. In mid-June, the scientists from the Max Planck Institute for Metals Research in Stuttgart were awarded the Science Prize endowed with 50,000 euros by the Stifterverband für die Deutsche Wissenschaft for their work on non-adhesive bonding. The female names belong to three spiders that meandered about without losing adhesion – a phenomenon that inspired Arzt and his team of three zoologists at the Stuttgart-based Max Planck Institute for Developmental Biology. Why don't geckos, flies or beetles fall off when they walk around upside down, or on glass? And how do they find a grip even on rotating surfaces? These were the questions that set Arzt and his team off on their way to find new systems of adhesion. They discovered that geckos and the like have tiny hairs on their pads; the heavier the creature, the finer and more numerous the hairs. Similarly, the shape of the hairs plays an important role. Using these biological examples, the materials researchers developed mathematical models and created technical surfaces with the appropriate characteristics: adhesive systems with which connections can be made and unmade thousandfold. The process has already been patented.

Side by side: Max Planck President Peter Gruss (left) and Argentine President Nestor Kirchner in a demonstration of German-South American partnership.

PHOTO: AXEL GRIESCH

BUENOS DÍAS ARGENTINA: Accompanied by a large contingent of members of government, Argentine President Nestor Kirchner paid a visit to the Max Planck Society in Munich as part of his state visit to Germany. At the Max Planck headquarters on Hofgartenstrasse, he inquired into the tasks and objectives of the organization and into the cooperation between Max Planck Institutes and research facilities in Argentina. Buenos Aires native Thomas Jovin, Director at the Max Planck Institute for Biophysical Chemistry in Göttingen, did the honors in Spanish. Jovin is an honorary professor at the University in Buenos Aires and works closely with one of three partner groups the Max Planck Society has set up in this South American country. The groups are headed by former guest scientists at Max Planck Institutes following their return to their home institutes, and are granted annual funding of up to 20,000 euros. Joint German-Argentine scientific research groups are also working on 10 other projects. In fact, in the past year, a total of 63 guest scientists and scholarship students from Argentina have worked at various Max Planck Institutes. The present and future German-South American partnership was sealed in writing in a joint statement on current and planned research projects. Three bilateral scientific workshops in Buenos Aires are planned for November 2005 in the fields of molecular biology, nanotechnology and legal science.

GOOD FRIENDS PAY A VISIT: A brief visit by a delegation headed by Director General Bernard Larrouturou bore a clear imprint of the cordial relations with colleagues at the French Centre de la Recherche Scientifique (CNRS). Larrouturou brought news of positive developments in France: for example, after substantial reductions in recent years, the budget of the CNRS has been sharply increased once again. Another topic of discussion was the European Science Foundation (ESF). Both sides agreed that their activities must become more strongly integrated. In addition, Max Planck President Peter Gruss and the CNRS Director signed a letter of intent to extend cooperation at the Institute for Radio Astronomy at Millimeter Wavelengths (IRAM) until 2014. The Institute, which is funded jointly with the Spanish Instituto Geográfico Nacional, operates two observatories in France and Spain.

ALL GOOD THINGS COME IN FOURS: The last Bernstein Center for Computational Neuroscience funded by the German government opened its doors in Munich. Like its three sister facilities in Göttingen, Freiburg and Berlin, this is a center of neuroscientific cooperation. Together, the four centers form a national network that is capable of carrying out detailed studies aimed at improving our understanding of the complex workings of the brain and nervous system in their entirety. The German Ministry of Research has earmarked funding totaling some 34 million euros for the network – the center in Munich alone will receive eight million euros. Besides the Faculties of Medicine and Biology at Munich's Ludwig Maximilian University, cooperation partners include the Physics Department and the Faculty of Information Technology at the Technical University Munich, as well as the Max Planck Institute of Neurobiology and Infineon. The network brings together research projects that focus on space-time relationships in neural information processing. The Max Planck Institute for Dynamics and Self-Organization in Göttingen is a further Max Planck Society Institute that is involved with one of the Bernstein Centers.