TIMELINE

Birth of a new institute — Biopolis Dresden

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Molecular cell biology is now facing the challenges of the post-genomic era. In this regard, the recently established Max-Planck-Institute of Molecular Cell Biology and Genetics in Dresden, Germany, provides interesting perspectives. Its atypical structure and the unique mixture of research topics and model systems give this Max-Planck-Institute the necessary versatility and flexibility for this new phase of biology.

After the unification of Germany in 1990, the Max-Planck-Society (Max-Planck-Gesellschaft, MPG) made a commitment to establish about 20 new Max-Planck-Institutes (MPIs) in the 5 New States (Neue Länder) and former East Berlin, to harmonize the research opportunities throughout the country and to increase the repertoire for meeting the scientific challenges of the future. One of the institutes created in this context is the MPI of Molecular Cell Biology and Genetics in Dresden.

Founding the MPI (1994–1997)

The founding of this MPI was a relatively long-winded process with several decisive steps. In the original concept, developed in 1994 by a group of Scientific Members of the MPG, including Christiane Nüsslein-Volhard, Günther Gerisch, Dieter Oesterhelt and Klaus Weber, the new institute was to concentrate on three fields of research: genetics, molecular cell biology, and folding and degradation of macromolecules. The research of the institute was to be carried out in eight departments, each headed by a Max-Planck-Director. And prime candidates for the location of the institute at that time were either the city of Halle in Saxony-Anhalt or Jena in Thuringia, two New States with fewer MPIs than others. But it proved difficult to recruit a team of principal investigators that were willing to take on the challenge of building such an institute and, by the end of 1995, it was far from certain whether the idea of creating this institute could be turned into reality.

From my own personal perspective, a turning point was a meeting with the MPG Search Committee on 8 January 1996. Being asked to present a concept for the new MPI if I were appointed as one of the directors, I had prepared a one-page overhead with a few ideas, of which the following turned out to be the most important: first, regarding the theme of the institute, that the aim should be to merge molecular cell biology and developmental genetics, with structural biology being a desirable complement provided that it was affordable; second, that the institute should be situated in Dresden, Saxony; and third, reflecting the imprinting that I had received during the wonderful five years (1985–1990) in the Cell Biology Programme of the European Molecular Biology Laboratory (EMBL), that the institute should not be divided into departments headed by one Max-Planck-Director each, which is the structure of a typical MPI, but that it should be characterized by a network of research groups, with the Max-Planck-Directors being just senior research group leaders, and out-numbered by junior ones. For the build-up phase of the institute, I suggested the recruitment of a kind of 'Director General', as a '*primus inter pares*' among the directors: Kai Simons.

The Search Committee approached Kai, and he accepted the challenge, which gave the entire project enormous momentum. Kai convinced Tony Hyman and Marino Zerial at EMBL to join the Finnish–German–Italian–English quartet of founding directors, and, by the summer of 1996, the concept of the new institute had matured such that the Search Committee felt confident to present it to the decision-making bodies of the MPG. Both the concept and our nomination as founding directors were approved by the Senate of the MPG on 7 March 1997.

Negotiations with the MPG and settling Dresden as the site for the new institute took the remainder of 1997. For various reasons, the financial resources for our institute that the MPG was able to make a commitment to in 1996–1997 were less than in the original 1994 plan, corresponding to about five departments instead of eight. Fortunately, the MPG supported the concept of using the available resources for an institute, the structure of which, by traditional MPG standards, was unusual: 5 relatively small groups headed by directors (a fifth director was still to be appointed) plus 19 research groups headed by scientists at the assistant professor or associate professor level. Consensus was also reached about placing the institute in Dresden: not only its geographic location, optimal for developing scientific links to Eastern Europe, but also the presence of an excellent Technical University, a key factor in our future scientific concept, were decisive arguments in its favour (see below). So, on 6 December 1997, the four of us signed our contracts with the MPG — using one and the same pen. At last, effective from 1 January 1998, the new MPI of Molecular Cell Biology and Genetics in Dresden was founded.

The build-up phase (1998–2000)

How can a bunch of enthusiastic scientists build a new institute without this task having the side effect of them losing touch with the

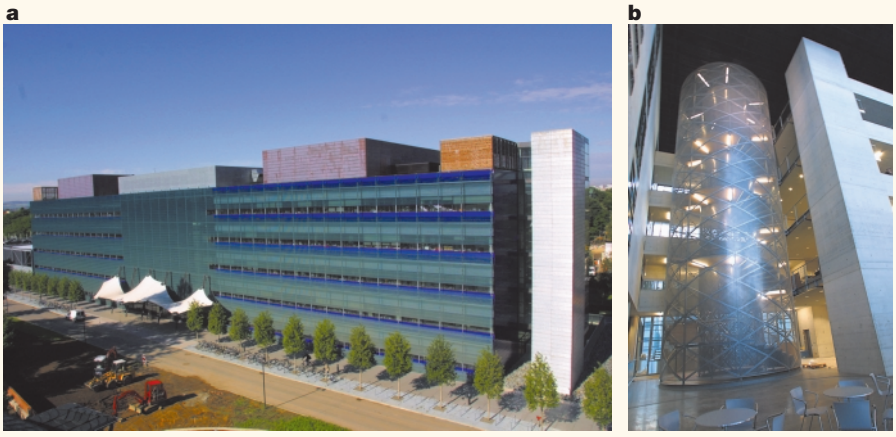

Figure 1 | **The MPI of Molecular Cell Biology and Genetics in Dresden, Germany.** The institute was built by a Finnish–German consortium of well-known architects, Heikkinen–Komonen (Helsinki) and Henn (Munich). **a** | View of the institute from the roof of a nearby villa. **b** | The atrium and staircase.

frontiers of their field? How can enough momentum be developed to generate broad excitement about the potential of a new place? I would say that, with hindsight, two elements were crucial. First, the fantastic team spirit among the principal investigators. This spirit spread, like an infectious virus, from the initial quartet to not only our fifth director, Joe Howard, but every research group and facility leader recruited. Second, the fact that we were 'shielded' by our home institutions — EMBL and the University of Heidelberg — until the new institute building was completed. In planning the build-up phase, we had decided against the option of moving into interim quarters in Dresden. Rather, we had urged the MPG to raise the new institute building in record time, which they did: it took less than two years from breaking the ground until we moved into the laboratory building at the end of January 2001 (Movie 1).

The advantages that the four founding directors saw in remaining at EMBL and the University of Heidelberg during the three years it took to plan and raise the new building were at least threefold. First, starting from scratch, we would be able to build up the critical mass of researchers for the new institute while still being in a critical mass environment in our home institutions. Second, we would be in a position to set up a functional institute before populating it with researchers. And third, we would be able to do all this and at the same time continue our own research.

By and large, this plan worked. Out of the projected 24 research group leaders, 19 have so far been recruited to work in Dresden. Of these, 12 moved into the new laboratory building at the same time, at the end of January 2001, and six others (including our fifth director, Joe Howard) arrived during the subsequent six months. More than 100 researchers and support staff populated the new building at the beginning of this year, and by now their number has increased to almost 200.

In parallel with recruiting researchers and support staff, every effort was made to ensure that the new institute would be ready for carrying out experimental work as of February 2001. Ordering all laboratory equipment (from magnetic stirrers to ultracentrifuges, from vortexes to electron microscopes) and having projectors in the auditorium is one thing. Another is to establish an efficient administration, set up the computer network of the institute and link it to the rest of the world, have an attractive library in place, and ensure the presence of an operational canteen. The last aim was of particular concern to at least one of the directors, Marino Zerial, who took charge, and I gladly confess that I do not miss the Mensa of Heidelberg University at all!

There were also things that, in the beginning, did not work at all. The telephone system, for example, was a total mess. Symptomatically, in mid-February, I received a present from one of the group leaders — two cardboard cups connected by a cord and labelled 'director's telephone'.

All in all, however, this phase went according to plan. An impressive laboratory building (FIG. 1) near the city centre and close to the river Elbe, largely functional in technical terms and requiring only minor architectural adjustments, was handed over to us on the 22 January 2001. In the following days, the bulk of the scientific equipment was delivered and installed. The next week saw truck after truck (about 30 in total) of the moving company pull up in front of the institute, most of them coming from Heidelberg, and also from Berlin (Temo Kurzchalia's group) and Göttingen (Marcos Gonzáles-Gaitán's group). With unloading complete, a great lab-warming party took place on Friday, 2 February. The first experiments in our new laboratories were carried out in the following week.

The team

When still in Heidelberg, we were frequently asked whether it would be difficult to recruit truly outstanding scientists from all over the world as members of our faculty. It was one of the most pleasant experiences during the past years that this was not a problem. Perhaps the beauty of re-built Dresden (FIG. 2), its culture and the gorgeous surrounding landscape, contributed to the ease we had in recruiting. Our present faculty (FIG. 3) features about ten nationalities, with less than half of all research group leaders being German, and the official language in the institute is English. We consider it a particular success that, in 1999, we were able to attract Joe Howard, an Australian biophysicist from the University of Washington (Seattle, USA), to become the fifth director of our institute. Recruiting a biophysicist meant a modification of the original 1996 concept in which the fifth director was supposed to be a geneticist, given that only one of the four founding directors, Tony Hyman, had a background in genetics. However, of the 15 research group leaders recruited since the founding of the institute, 9 are geneticists or have a strong background in genetics (BOX 1). Hence, with the field of genetics being already adequately represented in our MPI, we were in a position to meet another requirement of future molecular cell biology that had emerged since the original concept had been conceived: the need for biophysical approaches.

When recruiting the faculty for a new academic institute, there is not only opportunity, but also risk. I am not referring to the obvious risk of a recruitment not turning out to be as successful as expected, but to that of cementing a faculty structure. How do you provide the necessary degree of continuity and at the same time allow for flexibility? It is significant that the oldest and youngest directors of our institute are separated in age by 25 years and so retirement will not strike in clusters, providing continuity in the leadership of the institute. On the other hand, constant flexibility, that is the ability to adapt the research activities of our MPI to the themes emerging in the field, is ensured by the fact that the majority of the group leader positions are non-tenured and, hence, by the option of re-filling these positions once a group leader of our MPI moves to another institution.

Figure 2 | **The beautiful city of Dresden.**

Molecular cell biology in Dresden

What, then, is our scientific concept? Over the past two-and-a-half decades or so, molecular cell biologists have dissected several basic cellular mechanisms. A great deal of insight has been gained from studies using the most commonly used single-cell model organism, *Saccharomyces cerevisiae*, and higher-eukaryotic model cell lines such as fibroblasts, MDCK cells or PC12 cells. There seem to be two principal directions that molecular cell biology can take in the future. First, it can progress from molecular to atomic cell biology. In essence, this means introducing, into structural biology, approaches that allow the monitoring of the dynamics and interactions of individual molecules. Second, molecular cell biology can develop into molecular tissue biology. It is this latter direction that most of the research at the Dresden institute is taking, with the inclusion of biophysical approaches in our scientific concept adding research elements related to the first of the above-mentioned directions.

The overall questions to be addressed are: how are the basic molecular mechanisms that operate in eukaryotic cells used, and modified, to generate the various cell types in our tissues? How do cells organize themselves to form tissues, and to maintain and regenerate them? These questions are being investigated using, for the most part, the four animal model organisms for which the complete sequence of the genome is, or soon will be, available, and that lend themselves to genetic and genomic approaches: the worm *Caenorhabditis elegans*, the fly *Drosophila melanogaster*, the zebrafish *Danio rerio* and the mouse. Amphibian model systems with unique advantages for studying development (*Xenopus laevis*) and tissue regeneration (salamander) complement these efforts and, of course, *Saccharomyces cerevisiae* still serves as a point of reference for fundamental cellular mechanisms.

To address these questions, research in the institute occurs at various levels: at the single-molecule level, be it the crystal structure of a protein or its dynamics in the living cell; at the level of basic molecular assemblies, be it protein complexes that regulate the cell cycle, microtubules that separate chromosomes in mitosis, or lipid rafts that serve as platforms for signal transduction; at the level of specific organelles, with an emphasis on membrane compartments that directly participate in tissue formation, that is the plasma membrane and its intracellular counterpart, the endosomes; at the level of defined cells such as neural stem cells, studying them during embryonic development as well as during regeneration in the adult; and, finally, at the level of multicellular organization, ranging from structuring 'simple' epithelia, such as the *Drosophila* wing, to complex processes, such as gastrulation or the patterning of certain brain regions.

Biopolis Dresden

Given this scientific concept, why was the presence of a Technical University a decisive factor in favour of establishing our MPI in Dresden? The answer is simple — nanotechnology. Modern engineers are increasingly striving to design machines that operate at the nanometre scale. Molecular cell biologists, on the other hand, have been studying an entirely different class of machines that,

Figure 3 | **Faculty of the MPI of Molecular Cell Biology and Genetics in Dresden on a retreat in the 'Erzgebirge' (Ore-Mountains) near Dresden.** RGL, research group leader; FL, facility leader. From left to right, front row: Wieland Huttner (RGL, director), Christian Dahmann (RGL), Christoph Thiele (RGL), Anthony Hyman (RGL, director), Daniel Müller (RGL), Stefan Diez (technology development), Thomas Müller-Reichert (FL, electron microscopy); second row: Ines Kaestner (secretary, Ph.D. programme), Carl-Philipp Heisenberg (RGL), David Drechsel (FL, protein expression), Karla Neugebauer (RGL), Bianca Habermann (FL, bioinformatics), Kai Simons (RGL, executive director), Suzanne Eaton (RGL), Wolfgang Zachariae (RGL), Elly Tanaka (RGL), Glenis Wiebe (FL, DNA sequencing), Christiane Walch-Solimena (RGL), Marcos Gonzáles-Gaitán (RGL); back row: Ivan Baines (director of scientific facilities and services), Matthias Bochtler (RGL, at IIMCB in Warsaw), Frank Buchholz (RGL), Michael Brand (RGL), Jonathon Howard (RGL, director), Claudia Lorenz (FL, public relations), Paul Verkade (FL, electron microscopy), Kurt Anderson (FL, light microscopy and imaging), Tony Ashford (FL, antibodies), Marino Zerial (RGL, director), Teymuras Kurzchalia (RGL).

interestingly, operate at the nanometre scale, and do so with high efficiency (think, for example, of the mitochondrial proton pump). Hence, molecular cell biologists may teach engineers about novel ways to construct their machines, and, conversely, the challenges that engineers are facing may promote the awareness of molecular cell biologists about the potential applications emerging from their results. Developing this new discipline at the interface of molecular cell biology and engineering — molecular bioengineering — is one of the aims of the interaction between our MPI and the Technical University Dresden.

However, establishing a critical mass in Dresden to be competitive in this new discipline requires more than our new MPI and the existing institutes of the Technical University Dresden. Thanks to the generous support of the State of Saxony and a private foundation, two additional new institutes, in the creation of which Kai Simons has been both initiator and motor, will be built in the immediate vicinity of our MPI. One is the Bioinnovation Centre, in which five newly appointed Full Professors of the Technical University Dresden in the fields of functional genomics, functional proteomics, cell machines, tissue engineering and biophysics will be housed under one roof with biotech start-up companies. The other is a Centre for Computational Biology, which will be built as an annex to the Lingner castle, just across the river Elbe from our MPI, and which will be the home of a sixth newly appointed Full Professor of the Technical University Dresden in bioinformatics. An important aspect of these two new centres is that here, academic research will be interfacing with the biotech industry, an exciting prospect that has induced Michael Brand, a research group leader of our institute, to coin the term 'Biopolis Dresden'.

Establishing this interface requires an expertise that is still rare. We were fortunate that we could recruit a top administrator from the National Institutes of Health, Ivan Baines, who joined our team in 1999 and, with tremendous enthusiasm and many new ideas, took on the challenge of shaping two key aspects of Biopolis Dresden. First, he directs the scientific facilities and services of our MPI (BOX 1), which will be the core of a common infrastructure for Biopolis Dresden. Second, he supervises the founding of biotech start-ups that are emerging from our MPI, and coordinates the interface between biotech companies and the academic institutions of Biopolis Dresden.

Crucial support for our MPI, and Biopolis Dresden in general, has come from the pioneer of molecular cell biology, Günter Blobel. It was therefore most fitting that the first scientific symposium held in our institute was the one in honour of his 65th birthday, entitled *Principles of Protein Targeting and Sorting in the Cell* (23–26 May 2001).

The Eastern European vision

Another key argument for establishing our MPI in Dresden has been to exploit its geo-

Box 1 | **Organization of the MPI of Molecular Cell Biology and Genetics**

Research group leaders
- Matthias Bochtler (located at the International Institute of Molecular and Cell Biology, Warsaw, Poland), Protein degradation
- Michael Brand, Development of the zebrafish nervous system
- Frank Buchholz, Mouse genetics
- Christian Dahmann, Compartment boundaries in animal development
- Suzanne Eaton, Cell biology of signalling and polarization in *Drosophila* development
- Marcos González-Gaitán, Cell signalling and endocytosis
- Carl-Philipp Heisenberg, Genetic and cellular control of gastrulation movements in zebrafish
- Jonathon Howard (Director), Mechanics of motor proteins and the cytoskeleton
- Wieland Huttner (Director), Neurogenesis in the mammalian central nervous system
- Anthony Hyman (Director), Mechanisms of chromosome movement at mitosis
- Teymuras Kurzchalia, Caveolae and protein sorting in epithelial cells
- Daniel Müller, Function, assembly and interactions of membrane proteins
- Karla Neugebauer, Organization of the cell nucleus
- Andrej Shevchenko, Mass spectrometry of proteins and lipids
- Kai Simons (Executive Director), Cell surface polarity and the function of lipid rafts
- Elly Tanaka, Cellular mechanisms of regeneration in vertebrates
- Christoph Thiele, Cell biology of lipid–protein interactions
- Christiane Walch-Solimena, Regulation of post-Golgi vesicular transport
- Wolfgang Zachariae, Control of cell division by proteolysis
- Marino Zerial (Director), Molecular mechanisms of intracellular transport

Scientific facilities and services, Director: Ivan Baines
- Animal house, Jussi Helppi
- Antibodies, Tony Ashford
- Bioinformatics, Bianca Habermann
- Computer and network, John Duperon and Jeff Oegema
- DNA sequencing, Glenis Wiebe
- Electron microscopy, Thomas Müller-Reichert and Paul Verkade
- Light microscopy and imaging, Kurt Anderson
- Mass spectrometry, Anna Shevchenko
- Photoshop, Kostas Margitudis
- Protein expression, David Drechsel
- Public relations, Claudia Lorenz
- Research grants and technology transfer, Ivan Baines
- Transgenic core facility, N.N.

Technology development
- Stefan Diez, Photonics and optical technology development

Support services
- Administration, Building maintenance, Canteen and Cafeteria, Guesthouse, Library, Media kitchen, Workshop

Figure 4 | **Biopolis Dresden's existing and anticipated ties to Eastern European countries.** The MPI of Molecular Cell Biology and Genetics in Dresden hopes to develop scientific ties to Eastern European countries, in particular to Poland, the Czech Republic, Slovakia and Hungary. A first such link, to the International Institute of Molecular and Cell Biology in Warsaw, Poland, has already been established.

graphic location as the most Eastern of Germany's large cities to develop ties in science to Eastern European countries, in particular those that are prime candidates to join the European Union in the near future (FIG. 4). A first such link has already been established. One of the research groups of our MPI, headed by Matthias Bochtler, a crystallographer trained by Robert Huber, is not located in the Dresden institute, but at the International Institute of Molecular and Cell Biology in Warsaw, Poland. Not only does this research group contribute the element of structural biology to the overall concept of our MPI, it will also serve as a model for establishing scientific interactions between Biopolis Dresden and centres of excellence in, for example, the Czech Republic, Slovakia and Hungary (FIG. 4).

The huge potential of Eastern Europe was also strikingly revealed in March this year, when the first selection of doctoral students for our international Ph.D. programme was held. This programme, called the International Max Planck Research School of Molecular Cell Biology and Bioengineering, is a joint activity between our MPI and the Technical University Dresden. The excellence of applicants, in particular from Eastern European countries, surpassed all our expectations.

But this event stirred excitement beyond the satisfaction of being able to recruit talented graduate students. With the European Union expanding towards the East, the future of European science gains an additional dimension. It is a fascinating perspective that Biopolis Dresden might become one of the catalysts for the integration of Eastern European countries into a United Europe of Science.

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Links

FURTHER INFORMATION Max-Planck-Society | MPI of Molecular Cell Biology and Genetics in Dresden | Technical University Dresden | International Institute of Molecular and Cell Biology (IIMCB), Warsaw, Poland | Ph.D. programme | Research at the institute

"Biopolis Dresden may become one of the catalysts for the integration of Eastern European countries into a United Europe of Science."

"There seem to be two principal directions that molecular cell biology can take in the future. First, it can progress from molecular to atomic cell biology… . Second, molecular cell biology can develop into molecular tissue biology."

http://www.mpi-cbg.de/videos/first.mov

Links:

Max-Planck-Society
http://www.mpg.de

MPI of Molecular Cell Biology and Genetics in Dresden
http://www.mpi-cbg.de

Research at the institute
http://www.mpi-cbg.de/content.php3?lang=en&aktID=research

PhD programme
http://www.mpi-cbg.de/content.php3?lang=en&aktID=phd

Technical University Dresden
http://www.tu-dresden.de

International Institute of Molecular and Cell Biology (IIMCB), Warsaw, Poland
http://www.iimcb.gov.pl

Author biography:

Wieland B. Huttner is one of the five directors of the MPI of Molecular Cell Biology and Genetics in Dresden. He studied medicine at the Universities of Hamburg and Oxford, and received his doctoral and post-doctoral training at the University of Hamburg, the MPI of Experimental Medicine and Yale University, where he worked with Paul Greengard. After working as group leader at the MPI of Neurobiology and in the Cell Biology Programme at EMBL, he became Professor and Chair of the Department of Neurobiology of the University of Heidelberg, from where he moved to Dresden this year. His research has focused on protein tyrosine sulphation, the biogenesis of neurosecretory vesicles and, recently, neurogenesis in the mammalian central nervous system.

Movie 1 | Recording of the construction of the MPI of Molecular Cell Biology and Genetics in Dresden from 29 April 1999 to 30 October 2000. The institute was built by a Finnish–German consortium of well-known architects, Heikkinen–Komonen (Helsinki) and Henn (Munich).