

## Virulence profile: Bernhard Hube

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### Tell us About Your Early Days

Although born in Cologne, I grew up in the north of Germany in Hamburg and on a small East Frisian island in the North Sea, today part of a National Park and a UNESCO World Heritage site. Here, I was always surrounded by nature: the sea, the shore and migrating birds. I can hardly remember any free time or holidays when I was not doing sport or outdoor activities: kayaking, hiking, camping. These activities certainly influenced my wish to choose a future profession in the field of biology. Therefore, after finishing school, I went to Göttingen to study biology and, afterwards, a PhD in microbiology. From Göttingen I went to Aberdeen, Scotland, as a postdoctoral fellow, then to Hamburg and Berlin as a group leader, and finally to Jena: almost a circle on the map of Europe.

### When did You Decide to Become a Scientist?

I have always been interested in biology; however, there were 2 key experiences which influenced my decision to study biology. The first was the observations I made during a course in animal behavior at high school. I prepared an aquarium for sticklebacks and had the luck to have female and male fish in just the right phase for mating. They behaved precisely as described in the text book (by Niko Tinbergen), and performed a series of mating rituals. I was fascinated how detailed science could predict and describe such biological procedures triggered by simple and basic signals. The second was when I read a book written by the ethologist and Nobel laureate Konrad Lorenz (the Noble prize was joint with Tinbergen). He

stressed how important it is to make observations in nature and to draw conclusions from these observations and that, if you really have the skills to observe, you will become a scientist. However, my interest in biology was almost spoiled by an incompetent biology teacher. Luckily later on, I had a very good biology teacher who restored my enthusiasm for the subject. School teachers can have an enormous influence on your future.

### Tell us About Your Education and Experiences at University

When I went to university, I planned to specialize in zoology or botany, and my interest in biochemistry or microbiology was limited. However, when I reached the stage that I had to memorize the names of all the different animal bones and plant morphologies, learning about biochemical pathways appeared in a new light and I changed my career plans. I was also influenced by the microbiology lectures of Hans Günther Schlegel and his book on general microbiology. It was intriguing to see that the entire world can be seen and described from the perspective of microbes.

### When and Where did You Start Your Own Lab?

Although I supervised students in my own group as a postdoc in Hamburg in 1995, I established my first independent group at the Robert Koch Institute (RKI) in Berlin in 2000 with my own scientific research topics, group members and budget.

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## How Many People Work in Your Lab?

Currently, 25 people work in my laboratory at the Hans Knöll Institute (HKI) in Jena, a small university city in the middle of Germany with a large cluster of scientific institutions including 2 universities, Leibniz-, Fraunhofer-, and Max Planck-Institutes, and home of the famous companies Schott and Carl Zeiss Jena ([www.leibniz-hki.de/en/microbial-pathogenicity-mechanisms.html](http://www.leibniz-hki.de/en/microbial-pathogenicity-mechanisms.html)). The laboratory is organized in 4 teams with postdoctoral team leaders: Sascha Brunke, Lydia Kasper, Selene Mogavero, and Katja Seider. Each team deals with one or a few scientific questions within the main topic of the department: pathogenicity mechanisms of human pathogenic yeasts. Each team consists of the team leader, PhD students, Master students, and/or undergraduate students, supported by 3 departmental technicians. It is a real privilege for me to work with these young and enthusiastic scientists in an exceptionally friendly, stimulating and supportive working environment.

## What is Your Position at Your Institution?

Currently, I am Head of the Department of Microbial Pathogenicity Mechanisms (MPM), Leibniz Institute for Natural Product Research and Infection Biology, Hans Knöll Institute Jena (HKI), Chair of Microbial Pathogenicity at the Friedrich Schiller University (FSU) Jena and I also hold an In-House-Professorship at the Center for Sepsis Control and Care (CSCC).

## What Areas or Topics does Your Lab Currently Focus on?

For many years, I have worked in the field of fungal infection biology, fungal molecular biology and host-fungus interactions. The main aim of my laboratory is to elucidate the pathogenicity mechanisms of human pathogenic fungi, using *Candida* species as model organisms.

Methodologies include functional genomics and *ex vivo/in vitro* infection models. In one of the key projects we study the molecular and cellular processes during the transition of the normally harmless colonizers of human mucosal surfaces, *C. albicans* and *C. glabrata*, from commensalism to pathogenicity within a host. Further areas of interest include extracellular enzymes, regulatory proteases, infection associated genes, iron acquisition, intracellular survival, invasion mechanisms, microevolution, morphology, and anti-fungal agent mode of action.

According to the principles of the Leibniz Association, we do basic research with perspectives for application: *theoria cum praxi*. Such translational aspects include new ideas for antifungal therapies, new drug targets, and the identification of biomarkers.

## Do You have Partners That are Important for Your Research Projects?

Our philosophy at MPM is to use methods and technologies to elucidate pathogenicity mechanisms, not to be limited to addressing scientific questions with the technologies we already have. Although we have broad expertise in genomics, *in silico* analyses, functional genomics, microbiology, cell biology, biochemistry, and infection biology, our philosophy requires collaborations with many other scientists with expertise that we don't have. At the HKI, we closely collaborate with my colleagues Ilse Jacobsen (Microbial Immunology) and Oliver Kurzai (Fungal Septomics), systems biologists, and other groups working on pathogenic fungi and doing natural product research ([www.leibniz-hki.de](http://www.leibniz-hki.de)). In Jena, we are integrated into the graduate schools "Jena School of Microbial Communication" (JSMC) ([www.jsmc.uni-jena.de](http://www.jsmc.uni-jena.de)) and the International Leibniz Research School (ILRS) ([www.ilrs.hki-jena.de](http://www.ilrs.hki-jena.de)), the local SFB/TransRegioFungiNet ([www.funginet.de](http://www.funginet.de)) and the Priority Program 1580 ([www.spp1580.uni-bonn.de](http://www.spp1580.uni-bonn.de)) of the Deutsche Forschungsgemeinschaft (DFG). We are, or have been, members of EU Marie Curie

Research Training Networks (GalarFungal, FINSysB, OPATHY ([www.galarfungal.org](http://www.galarfungal.org); [www.finsysb.eu](http://www.finsysb.eu))) and we coordinate the FunComPath consortium within the European Infect-ERA program ([www.infect-era.eu](http://www.infect-era.eu)). There are several further national and international collaborations, including Christophe d'Enfert at the Institute Pasteur in Paris, Alistair Brown at the University of Aberdeen, and Julian Naglik at King's College London.

## Who were Your Mentors?

During my PhD and until I had my own research group, I never had a mentor in the true sense of the word, who actively supported my career. However, there were people who gave me advice and helped and supported me in numerous ways: Reinhard Rüchel, my formal PhD supervisor, who taught me to be modest and to never forget the link between basic science and the medical problems patients suffering from mycoses have (he was the only physician I know who went to his patients' funerals); Rainer Thomssen, Head of the Institute where I did my PhD, who always supported and encouraged me; Frank Odds, one of the most acknowledged mycologists, who supported me in several ways and encouraged me to go to Aberdeen; Willi Schäfer, who supported my Habilitation at the University of Hamburg; Neil Gow, my supervisor as a postdoc in Aberdeen and a very good friend today who has supported and inspired me in multiple ways. He also taught me not to take science too seriously and to always approach life with a sense of humor, and, importantly, who introduced me to fly fishing.

## What was Your Most Significant Scientific Accomplishment?

After almost 3 years of hard and unsuccessful work during my PhD, I managed to clone and sequence the first virulence gene of the human pathogen *Candida albicans* (a protease gene) and one of the first virulence genes identified in a human

pathogenic fungus. I further worked on *Candida* proteases, which turned out to be encoded by an entire gene family, performed the first genome-wide *in vivo* and *ex vivo* *Candida albicans* transcriptional profiling from infected blood, infected tissues and patient material and characterized infection-associated genes and factors of *Candida* species that are crucial for pathogenicity.

### **What were Your “Highlights” in Recent Research Performed in Your Field?**

We have the luck to work in an amazing period of microbiology and infection biology where new technologies allow scientific progress and gain of knowledge at breathtaking speed. During my PhD period, it took 3–4 years to clone and sequence a *C. albicans* gene. Nowadays, a Master student can obtain the same results within 5 minutes with a few clicks of the mouse.



**About Bernhard Hube.** Dr. Hube graduated from University of Göttingen, Germany, where he also did his postgraduate studies (1987–91). He performed his postdoc research at University of Aberdeen, UK, in the lab of Neil Gow (1992–

5), whereupon he moved back to Germany, first to Hamburg as a senior postdoc (1995–6) and assistant professor (1996–2000) and then to Robert Koch Institute in Berlin as an independent group leader (2000–5) and head of Mycology division (2005–6). Since 2007 he has been a professor at Friedrich Schiller University in Jena, Germany, and head of Department of Microbial Pathogenicity Mechanisms at the Hans Knöll Institute of the Leibniz Association. Dr. Hube's research has always revolved around molecular and medical aspects of pathogenic fungi, in particular *Candida*. He has authored more than 170 papers on host-pathogen interactions, virulence factors (particularly *Candida* proteases), and others. He is the recipient of multiple honors and awards, including Seeliger Award (2003), Fellowship of the American Academy of Microbiology (2008) and Main Award of the German Society for Hygiene and Microbiology (2014).