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Profile

Thomas Carell

Professor of Chemistry, Philipps-University Marburg

Organic & Biomolecular Chemistry **profiles Professor Thomas Carell**

Thomas Carell was born in 1966 in Herford, a little city in the northern part of Germany. He lives with his wife, Birgit, and his three children, Christopher (8 years), Henrike (5 years), and Alexander (3 years), in Kirchhain near Marburg. Marburg harbors one of the oldest Universities in Germany. It is a pleasant, charming university city with a long history in chemistry, biology and immunology and an intellectual center in the middle of Germany. His hobbies include reading novels, biking, hiking, ice skating and, in the summer, swimming in one of the many lakes around Marburg.

1990: University of Münster, Dipl. chem., Supervisor Professor Burkhard Franck

1993: University of Heidelberg, Dr. rer. nat., Supervisor Professor Heinz A. Staab

1993–1995: Massachusetts Institute of Technology (MIT), Postdoctoral fellow, Supervisor Professor J. Rebek

1995–2000: Research Associate, ETH Zürich

2000: ETH Zürich, Dr. habil.

2000 to date: Philipps-University Marburg, Professor and Chair of Organic and Bioorganic Chemistry. Head of the interdisciplinary research group: Chemical and Biological Hybrid compounds and Materials (CBHM).

When did you first realize that you wanted to work in chemistry?

I read with great fascination in my early years books about explorers and discoveries. I was particularly thrilled by all activities aimed at learning more about the world around us. This interest was focused on chemistry, particularly the combination of chemistry and biology, by excellent and inspiring schoolteachers, first in the Realschule and later in my last three school years at the Gymnasium Lohfeld (Hr Benson and Dr Wittmann).

Who was the first person to inspire you to research in chemistry?

As a student in the Realschule (8–10 M grade) we had an inspiring young schoolteacher in biology (Mrs Grass), who taught us the chemical basics of biology in a fascinating way. During these years I started to set up a small chemical biology lab at home where bacteria that were collected with friends from a nearby pond, were grown on Agar plates.

Tell us something about the areas of chemistry you are currently researching?

DNA as the genetic material is the central point of our research. Using stereoselective chemistry, we synthesize DNA lesions in our lab that are responsible for cell death and mutagenic deterioration. These lesions are inserted into oligonucleotides using machine assisted solid phase synthesis methods. In the second research program we look at DNA and DNA-like compounds as being a material, which is perfectly suited to self-assemble into complex functional 2- and 3-dimensional molecular architectures. We synthesize in this field DNA-inspired materials with novel catalytic and conducting properties.

Why did you decide to research in these areas of chemistry?

I was always deeply fascinated by all types of research activities that were conducted to learn about the molecular basis of life. Here the DNA molecule, and the fact that the sequence of rather simple purine and pyrimidine heterocycles provides the basis for all life on earth, is still a great mystery. DNA repair is at the very heart of the problem of how organisms establish a stable but still flexible genetic code that can be passed on to the next generation. Mutations, selection and the plasticity of our genetic material allow the establishment of individuality. On the other hand we need to have a stable genetic storage material in order to avoid cell death and cancerous

Photographs show Professor Carell and University buildings in Marburg.

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cell growth. Both properties are at the heart of life on earth.

Where would you like to see your research in both the short and long term?

We have now finished the synthesis of a few important DNA lesions and this has to be continued. The synthesis of unusual bases has to be extended to RNA, which also contains quite a number of highly modified nucleotides. So far we have inserted the DNA lesions only into small oligonucleotides for biochemical studies. Now, the first of these DNA strands are crystallizing in various labs around the world, together with proteins that in nature are responsible for the repair of these lesions and the copying of DNA. We hope that our efforts to provide enough DNA will be rewarded in the near future with fascinating novel co-crystal structures.

The first DNA-like materials with hopefully improved electron transport properties are now also emerging in our lab. Here we have to develop novel chemistry on new solid support materials. In the short term we hope that we will be able to perform conductance measurements together with groups at the Technion (Israel).

In the longer run, I believe, we will go into the cell to study repair and transcription of lesioned DNA in a living environment. We hope that this year will be the year where we will be able to make the first essential steps in this direction by establishing a cell culture lab.

What would you most like to achieve in your lifetime in chemistry?

I would love to see electrons hopping through synthetic DNA-like materials that are assembled between nanoelectrodes. Maybe neurons can also be introduced into such devices to create bioelectric circuits. In the DNA repair area I would like to see chemical entities that increase the vulnerability of cells toward cell toxic agents. Such compounds could strongly reduce the dosage of chemotherapeutic agents, which are now in use to treat many cancers. If I look at the side effects that these drugs have, any step in the direction of reducing the dosage seems to be of tremendous importance in our fight against these diseases.

What do you find most enjoyable about your job on a daily basis?

It is a tremendous privilege to work in a young team and to see that some of our ideas develop into fruitful projects that give fascinating results. The ability to learn life-long and to follow my own interests provides the strongest bonds to my daily work. Educating gifted students and having creative and enthusiastic people in the research group provides daily a feeling that I am living at the right time in the right place.

What frequently annoys you about your job?

The major problem is time. Much of our time and efforts flows into fruitless bureaucratic work. A hopeless overflow with review and book chapter requests, writing of recommendations, proposals and reports, consumes too much time. One frequently feels that the demand is far too high compared to what is possible. The family is too often the weakest point when time has to be distributed over the many necessary activities.

Which scientist/chemist do you most admire through history and why?

Looking at history I admire people like Galileo Galilei. They were not only exceptional scientists but in addition they had to fight a personal fight for their ideas and results.

If you could successfully solve any scientific problem, what would it be and why?

This is a very difficult question. I believe that I would like to know how our brain functions. Understanding brain functions in more detail may open up new avenues to treat horrible diseases that we cannot tackle today.

Making bioelectrical circuits on a chip is another fascinating area, where I would like to contribute significantly.

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