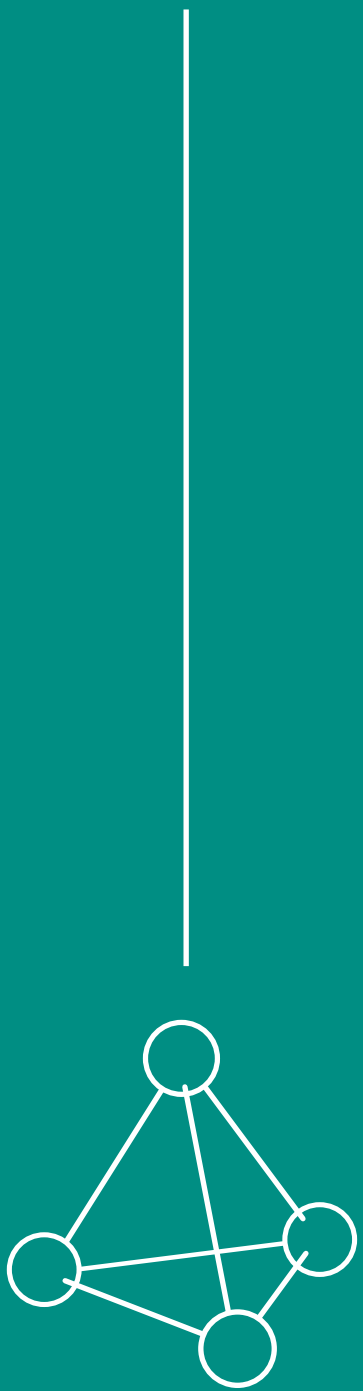
SUPPORTING MATERIAL



Karl Reuter: Origins of the Book Project and my Vision for it

Sept. 7th, 2021. Lecture of the sponsor Karl Reuter on the occasion of the series launch event. The Video ist available on Youtube: https://youtu.be/0FVTg8TSgnU.

German version: https://youtu.be/57xsCcLtFU8.

Further info on https://l-i-c.org/.

My name is Karl Reuter and I am 66 years old. I received my PhD in 1985 from the Justus-Liebig-University in Giessen where I was a member of Professor Günther Maier's Working Group in the Institute of Organic Chemistry. I subsequently worked for a large chemical company for 8 years, and for the last 26 years I have managed my own separation technology company.

I'm the initiator and sponsor of the book project, "Lives in Chemistry", which is being presented today, and Professor Carsten Reinhardt, Chairman of the German Chemical Societies "History of Chemistry" Division and Chairman of the Advisory Board for the book project has asked me to talk about the origin of this initiative in a short video.

How did the book project "Lives in Chemistry" come about?

My first answer is very simple. It is just the result of a series of coincidences. But, after all, what are coincidences?

When my mother-in-law was still alive, my wife, children and I always attended a family gathering in the Sauerland in the week after Easter. And on the way back home we would visit the Maier family in Marburg for a Saturday afternoon coffee. And so it was in 2015 when visiting Professor Maier that he told me he was about to write an account of his chemistry for his children. I was immediately taken by this idea and strongly urged him to do this, not only for his children, but also for all of his PhD students.

Now, why would I strongly urge him to do so?

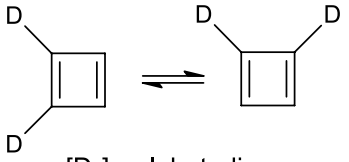
On December 1st 1997 Professor Maier held a German Chemical Society lecture on his chemistry in the Chemistry Department of Freiburg University. He had told me about this in advance and so I was in the audience.

He began to write with just a piece of white chalk at the top left-hand corner of the first blackboard and after 60 minutes he finished at the bottom right-hand corner of the fourth and last blackboard.

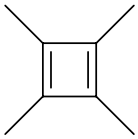
The chemistry that he presented to the auditorium during this hour was breath-taking, almost unbelievable: the synthesis of a "prohibited or impossible" molecule is always a sensation. He showed us nothing but such molecules (**Fig. 1.1.**):

- The whole range of *anti-aromatic cyclobutadienes*, and with it the electronically related trimethylenemethane and cyclopropenylidene,
- the unbelievable list of stable (!) *tetrahedranes*,
- *heteroaromatic compounds* such as silabenzene and borabenzene,

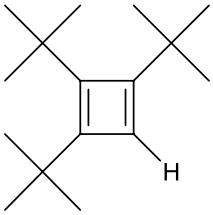
A. cyclobutadienes



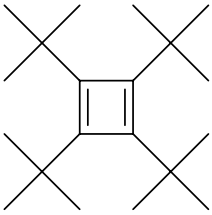
[D_2]cyclobutadiene



tetramethyl-
cyclobutadiene

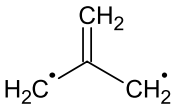


tri-*tert*-butyl-
cyclobutadiene

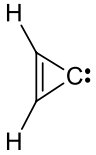


tetra-*tert*-butyl-
cyclobutadiene

B. related to cyclobutadiene

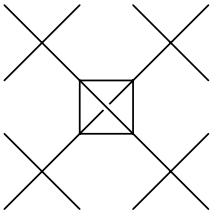


trimethylenemethane

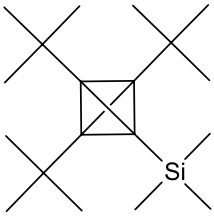


cyclopropenylidene

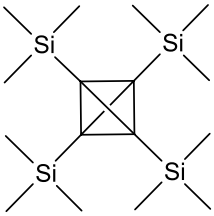
C. tetrahedranes



tetra-*tert*-butyl-
tetrahedrane

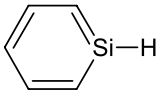


tri-*tert*-butyl-
trimethylsilyl-
tetrahedrane

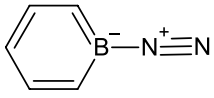


tetrakis-
trimethylsilyl-
tetrahedrane

D. heteroaromatic compounds

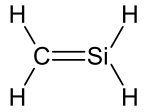


silabenzene

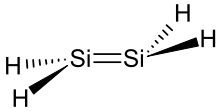


borabenzene

E. silicon double bonds



silaethene

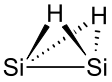


disilaethene

Fig. 1.1. The "prohibited or impossible" molecules presented by Günther Maier.

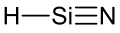
F. silicon triple bonds

formal



butterfly structure

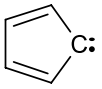
disilaethyne



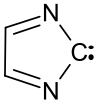
hydrogen silacyanide

G. carbenes

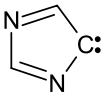
methylene



cyclopenta-dienylidene

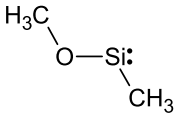


2H-imidazole-2-ylidene

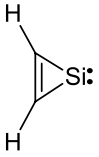


4H-imidazole-4-ylidene

H. silylenes



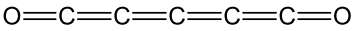
methoxymethylsilylene

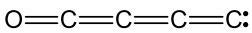


silacyclo-propenylidene

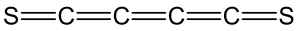
siladiazacyclo-propenylidene

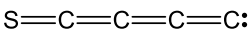
I. carbon suboxides

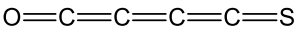




carbon subsulfides







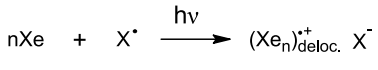
- *compounds with silicon double bonds* such as silaethene and disilaethene
- *compounds with silicon triple bonds* such as disilaethyne and hydrogen silacyanide
- *carbenes* such as methylene, cyclopentadienylidene and imidazolylidenes,
- *silylenes* such as methoxymethylsilylene, silacyclopropenylidene and siladiazacyclopropenylidene and
- *carbon suboxides* and *carbon subsulfides* with up to 5 carbon atoms

At the end of the lecture, it was clear that this man — by simply following his curiosity and interesting traces in his scientific everyday life — had in retrospective and as end result resolutely and systematically linked carbon atoms with carbon atoms or with heteroatoms in all possible, "impossible or prohibited" ways. He had generated these highly reactive species in a frozen state and characterized them and thus — molecule by molecule — he had explored the high valleys and summit hollows in the potential energy surfaces of elementary binding systems. He had thereby laid the experimental foundations for the transition of organic chemistry into the new digital era — that is for the theoretical calculation of transition states and ultimately reactions.

As a pioneer with an immense wealth of ideas and enormous technical skill, he had developed the chemistry for the appropriate precursors, suitable pyrolytic and photochemical procedures, the technique of matrix isolation, and the spectroscopic analysis of the molecules. And in close cooperation with theoreticians, he had compared his experimental data with theoretical calculation models. With that, he made a decisive contribution to the elucidation of fundamental bonding structures and he also discovered surprising structures and unexpected phenomena such as (**Fig. 1.2.**):

- the excitation of embedded molecules by a xenon-halogen-exciplex
- the isomerisation between dihalogeno methane and isodihalogeno methane
- sila cyclopropyne — maybe the most strained molecule in organic chemistry
- the phenomenon of quasi linearity by the example of propargylene and
- fundamentally new tunnel phenomena by the example of the transition of the two rotamers of oxalic acid monoamide (449 b to 449 a)

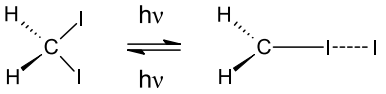
1. photochemistry in halogen-doped Xe matrices



211

exciplex **211** opens an unusual pathway to excite embedded molecules

2. isomerisation between dihalomethanes and isodihalomethanes

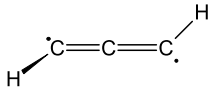


diiodo methane isodiiodo methane

3. silacyclopropyne

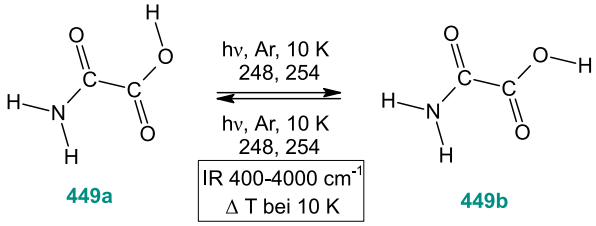
the most strained molecule in organic chemistry?

4. propargylene



quasilinear; no fixed structure

5. tunnel effect in the thermal transition of 449b to 449a



449a 449b

chemical kinetics not applicable

Fig. 1.2. Surprising structures and unexpected phenomena.

With that, he wrote an important piece of scientific history!

I was very impressed! Up until this lecture I knew only about 20% of his chemistry! My guess was that the same was so for the majority of my colleagues in the working group. And his chemistry was worth knowing about!

Professor Maier, in fact, actually did sit down and started to write, and at the celebration of my company's 20th anniversary at a venue overlooking the rooftops of Freiburg he handed me the first chapter of his scientific memoires as a present. I then urged him to complete the manuscript and told him that I was willing to act as publisher for the first edition.

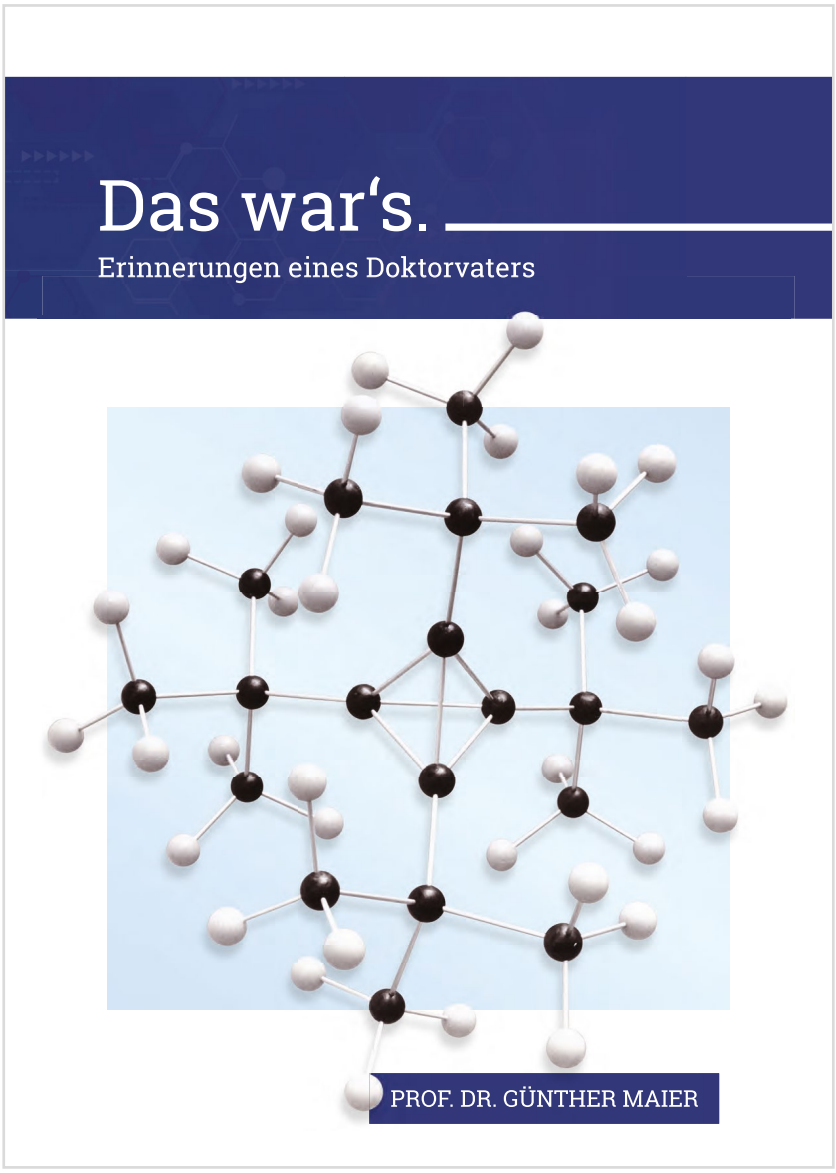


Fig. 1.3. Cover image of the first Maier book from 2017.

The Maier book was printed in time for Professor Maier's 85th birthday and it was received enthusiastically by over 100 of his PhD students who were present on that occasion (**Fig. 1.3.** and **1.4.**).

That was supposed to be the end of the story! But I was not satisfied! Professor Maier describes vividly and authentically how research is done—how he did it, how the ideas were developed, and how one thing led to another. I thought that this certainly must be interesting and enlightening for all those currently doing research, and that the Maier book should be available in every chemistry department library in Germany. However, that was not so simple to achieve…

But what was it all really about? What would actually make sense?

Fig. 1.4. Back cover of the first Maier book.

Wouldn't it be wonderful to let a number of eminent and really successful research scientists tell the story of their scientific life's work? And in contrast to progress reports or review articles, to let them explain how their thoughts and ideas had developed in context.

What were the fundamental, underlying questions? What were the goals? What was planned? What happened by chance?

What were the strategies and recipies for success or the virtues of that particular scientist — and I am certain that there are many different ones, some of them cultural and country-specific. What worked? What didn't?

How did the working relationships function with co-workers and students, as well as with colleagues in one's own institute as well as worldwide?

How did they deal with failures?

What were the external constraints, e.g. budgets for co-workers, equipment, etc. Was there goodwill and support from the public, from the media, from politicians?

Which obstacles had to be overcome and how did he or she deal with this?

Nota bene: There are many clever people! But only few of them have really pioneered new territory and left a rich scientific legacy.

Perhaps the individual stories of the most successful chemists of the last generation could be assembled like the pieces of a jigsaw puzzle to provide an overview that is not only instructive and enlightening but also an inspiration and incentive for many: for research scientists (PhD students, post-docs and professors) but also for politics, the media and society.

Innovations, new and really good ideas are the most important raw material for our country and indeed for the whole world! Anyone who believes that the world has already been invented is making a big mistake. We are just at the beginning!

In fact, such a project could be relevant for us all.

And: Hardly any other branch of science is so well suited as chemistry to be, so to speak, an experimental laboratory for the creative process, because:

1. Research in chemistry has a long tradition, particularly in Germany but also worldwide, and a very successful research culture has emerged. The very high proportion of chemists with doctorates in comparison to other natural sciences illustrates this.
2. In particular, as a result of modern, sophisticated and rapid methods of analysis (GC, HPLC, NMR, MS, etc.) and the excellent resources for literature searches, it takes only a few days or weeks to verify or implement an idea for a new substance with

special properties, a new route of synthesis etc.. And the experimental outcome is usually very quickly conclusive and clear — we are not kept in the dark for long. That is to say, one can make important discoveries in a very short period of time.

Let me add here the following three comments:

1. In my view, those research scientists (worldwide) who can look back on their acquisition of knowledge, their inventions and innovations in a wide-ranging, important field — not for military superiority but in the service of humanity and our planet and who have shaped the next generation of scientists — those men and women are the true pioneers, the true heroes of our world and our time. This means, of course, that the book project, from the very start, also would have to be international, since its focus is on important contributions to science, humanity and our planet.
2. Handing down the acquired wealth of knowledge and experience to the next generation is a beneficent, cultural necessity. I would like to pay special thanks to all authors who took on the task of doing this at the end of their scientific careers.
3. A book like this should, of course, also be a visible acknowledgement of life-long eminent scientific achievement.

Thus I approached Professor Maier yet again and suggested that we should start such a book project. His response was immediate: This proposal should be implemented without further delay!

Very soon we found the right top people for this project. Dr. Peter Gölitz (Executive Editor of Angewandte Chemie from 1982 until 2017); Professor Henning Hopf (until 2006 Managing Director of the Institute of Organic Chemistry at TU Braunschweig; Co-editor of the Chemische Berichte and Liebigs Annalen and Literature Expert for the Board of Directors of the German Chemical Society); and, of course Professor Carsten Reinhardt from the University of Bielefeld and Chairman of the German Chemical Societies "History of Chemistry" Division.

We were welcomed with open arms!

Professor Reinhardt had already found the right publishing company and Dr. Gölitz's wife, Dr. Eva Wille had more than 30 years' experience in scientific publishing and was a brilliant addition to our team.

And voilà! 18 months later we are now able to present the first three autobiographies. I am extremely grateful for the dedicated work of this group!

In conclusion let me return to my comment at the start of this talk: "But after all, what are coincidences?"

In 1995 I took the rather daring decision to give up a safe position in the chemical industry and to start my own company based on two new ideas for chemical separation.

It was the era of the New Economy and companies gave themselves corporate objectives and a motto.

I had only an idea in my head and not yet a business but the motto for RCA (my company) had already been created:

Pioneering the Genius in Man!

The motto was first of all meant to be an expectation of myself, but also of my employees as well as my customers and partners. This motto appeared on RCA's very first letterhead, which I soon removed, however, because it sounded very arrogant and potentially disparaging of others and because such a motto first has to be earned — though one can't ever actually earn it.

With all that in mind, I still find it appropriate to put this motto in front of the book project today:

Pioneering the Genius in Man!

For me, that is the essence of this project! May the book series be a contribution to it!

From the bottom of my heart, I am very grateful to all those who have made this project possible and to all those who — by contributing their commitment and their abilities — will make it successful and valuable.

Thank you!

And: Last but certainly not least, I wish this project all the success in the world!