



Patrick Cramer

Future Worlds

My Journey to the Science of Tomorrow

March 2024 | 336 pages

- The new President of the Max Planck Society provides an exclusive insight into the innovative research institutes
- Cramer visited all 84 Max Planck Institutes in Europe and the USA
- A fascinating journey into the future of science



Where tomorrow's science is made

Will we be able to develop alternative energy sources and thus avert the climate catastrophe? Will our democracies survive the challenges posed by new forms of communication and artificial intelligence? Will we be able to provide adequate medical care for an ageing society?

In search of answers to these and many other questions of the future, Patrick Cramer visited the 84 institutes of the Max Planck Society before taking over its presidency. In the process, he met passionately researching scientists and got to know the future worlds that are just beginning to emerge in their minds. From astronomy and climate research to biomedicine and artificial intelligence to energy research and social sciences – Cramer takes us into the engine rooms of research and provides exclusive insights into the science of tomorrow.

Patrick Cramer, born in Stuttgart in 1969, studied chemistry in Stuttgart, Heidelberg, Bristol and Cambridge. After research stays at EMBL Grenoble and Stanford University, he researched and taught at LMU Munich. From 2014 to 2021, he was Director at the Max Planck Institute for Biophysical Chemistry in Göttingen, and from 2022 he headed the Max Planck Institute for Multidisciplinary Natural Sciences. In June 2022, he was elected President of the Max Planck Society. Before taking office in June 2023, he visited all 84 institutes to gain an overview of their diverse research activities.

Sample Translation

© S. Fischer Verlag GmbH

Contents

Foreword 7

Chapter 1 Our place in the universe	13
Chapter 2 The complex system Earth	35
Chapter 3 Threatened ecosystems	54
Chapter 4 Humans and evolution	72
Chapter 5 Cells and life	89
Chapter 6 Developments in medicine	110
Chapter 7 Ageing and regeneration	128
Chapter 8 Robots and artificial intelligence	147
Chapter 9 Quantum and novel materials	167
Chapter 10 Green chemistry and material cycles	186
Chapter 11 Energy from hydrogen	202
Chapter 12 Nuclear fusion and superconductivity	219
Chapter 13 Societies in transition	235
Chapter 14 Rules for living together	252
Chapter 15 Brain and memory	268
Chapter 16 Speaking, learning and acting	284
Chapter 17 Time and beauty	302

Epilogue 318

Appendix 325

Foreword

The idea for this book was born on the road – on a late summer's day in 2022 on the way from Heidelberg Castle up to the summit of the Königstuhl. The view of the romantic city in the Neckar valley brought back memories of old times: I came here as a chemistry student back in the early nineties. I often stood in the old laboratory hall in a white coat, with a glass apparatus bubbling away in front of me. But even then I was interested in something else: the chemistry of life. This yearning drew me to Bristol and Cambridge as a research student.

In 1994, I returned to Heidelberg to take part in a selection process for doctoral students. Like hundreds of other applicants, I wanted to get one of the few places at the European Molecular Biology Laboratory (EMBL). At the second attempt, I got the doctoral position I had longed for and spent a few years researching at a particle accelerator in Grenoble in the French Alps. I then went to Stanford University in California, did research at the Ludwig Maximilian University in Munich and finally moved to the Max Planck Society in Göttingen. Over the years, I kept coming back to Heidelberg, where I worked on a university advisory board and on the EMBL Council. So Heidelberg is familiar to me. But on this day in August 2022, it seemed foreign to me. I saw the city with different eyes, because just a few weeks earlier, on 23 June, my life had changed forever: I was elected President of the Max Planck Society, which required a new perspective on my view of science. I realised this once again during the drive up to the Max Planck Institute (MPI) for Astronomy, which is only a few kilometres away from EMBL.

I had been doing molecular biology for almost three decades. Our international research group was delving deeper and deeper into the secrets of genes. With my new role, however, research management, science policy and public relations work were to take centre stage much more than before. I asked myself how I could meet these new challenges and remembered how my academic career had begun in Heidelberg. What would it be like if I set off from here once again?

And so I decided to go on a big journey to prepare myself for my new task: I wanted to go in search of the science of tomorrow and visit the 84 institutions of the Max Planck Society, which are spread across 38 German and four foreign locations. I wanted to get as close as possible to current science and gain an overview of the diverse research activities in the humanities, social sciences and law, the natural and computer sciences as well as the life sciences and biomedicine. I wanted to meet people who do science and make it possible. I hoped to find out what goes on in the laboratories and thinking spaces and how new knowledge can shape the world of the future. Long before my trip, it was clear that research has a fundamental impact on our lives and changes the way we live, work and communicate together.

Will we develop alternative energy sources to avert the climate catastrophe? Will our democracies survive the challenges posed by new forms of communication and artificial intelligence? Will we be able to provide medical care for an ageing society? In my search for answers to these and many other questions about the future, I travelled to places that are difficult for most people to access. I immersed myself in underground library treasures, walked through research aviaries full of zebra finches and stood in amazement in front of huge plasma storage facilities. But the journey didn't just take me into the engine rooms of research. Much more important were my encounters with passionate researchers. I began a dialogue with around three hundred directors, research group leaders and representatives of the approximately 24,000 employees. During my trip, I sometimes had the impression that I was travelling around the world, as people from over one hundred countries work in the Max Planck Society. I learnt about future worlds that are only just emerging in the minds of the researchers. I was able to visualise where the horizon is expanding and what possibilities lie ahead of us. In order to learn new things, I collected ideas and dreams, worries and challenges. As a result, I did not remain a visitor, but became a traveller. I began to understand the different faculty cultures better. I also associated my journey with the hope of developing positive future scenarios.

Few are granted the opportunity to undertake such a fascinating journey. For this reason, I would like to share some of my impressions, experiences and insights with you. My travelogue cannot possibly even come close to reflecting the research that is carried out in such a large scientific organisation as the Max Planck Society. But the encounters described here can offer exemplary insights into the fascinating world of science. In order to present them, I have always taken into account the state of knowledge in the field of research and also included research results that were not produced in the Max Planck Society, but were developed by the global community. By embedding my discussions and experiences in the overall state of knowledge, a rough overview of the current research landscape emerges across the various subject areas. Again and again, I weave in open questions that need to be investigated. In this way, I hope to illustrate the process of gaining knowledge and encourage you to take a closer look at selected fields of research.

The starting point for my visits to the institutes was Göttingen, where the Max Planck Society was founded in 1948. From here, I travelled by train almost every week between August 2022 and April 2023. In this book, however, my visits to institutes are not organised chronologically or by location, but rather I have arranged selected experiences around the future topics of science. The chapters therefore revolve around the great mysteries of research and the challenges of research fields to which several institutes contribute. I expressly ask for your indulgence that I can only present the research activities of the Max Planck Institutes in fragments and that the activities of other research organisations and universities in Germany and abroad are not explicitly mentioned, although they make many fundamental contributions. I also ask for your understanding that I only mention a few Nobel Prize winners by name, although I met over a thousand researchers.

So I can now invite you on a completely different journey than the one I have undertaken myself in many small stages, a journey that can only take place in the mind – a journey into future worlds. The route first takes us through the vastness of the universe to our home planet with all its

mysteries. On Earth, we wander through an endangered animal and plant world, then turn our attention to human creativity and explore the future of medicine, technology and energy production. Finally, we immerse ourselves in the fascinating world of human coexistence. We get an idea of how the big things come into the world, how knowledge, law and culture are created and what they mean for us humans.

And who knows? Perhaps at the end of the journey - as happened to me - you will come a little closer to yourself. Perhaps you will see your personal future worlds before you: your curiosity, hopes and options for action. If this happens, I would have achieved my goal with this book and would consider myself lucky.

This sample was generated with the assistance of artificial intelligence.