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FROM ATMOSPHERIC CHEMISTRY TO EARTH SYSTEM SCIENCE

CONTRIBUTIONS TO THE RECENT HISTORY OF THE MAX PLANCK INSTITUTE FOR CHEMISTRY (OTTO HAHN INSTITUTE), 1959 – 2000

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INTRODUCTION

The Max Planck Institute for Chemistry in Mainz (MPIC) has an eventful history that now spans more than one hundred years. In 1912, the institute opened as the Kaiser Wilhelm Institute for Chemistry (KWIC) in Berlin-Dahlem and together with the MPI for Physical Chemistry and Electrochemistry (Fritz Haber Institute) it is one of the two oldest institutions of the Kaiser Wilhelm Society that was re-founded in 1948 as the Max Planck Society. Due to heavy damage from bomb hits in 1944, the institute was evacuated to Tailfingen in the Swabian Alb (Albstadt, Baden-Württemberg)[9] and subsequently moved to Mainz in Rhineland-Palatinate, primarily under the leadership of the second director and one of the co-discoverers of nuclear fission, Fritz Straßmann (1902 – 1980). The MPIC remained at that location, on the campus of the Johannes Gutenberg University in Mainz that had reopened in 1946 on the site of former French military barracks, until 2012. The most recent move then brought the institute to its current new building, a few streets further away, located at Hahn-Meitner-Weg 1.

Over its history, researchers at the institute have worked in fields ranging from organic chemistry in the 1910s, to radiochemistry (until the mid-1950s) and physical chemistry (until the end of the 1970s), up to cosmo-, geo-, atmospheric, and biogeochemistry. In the course of the 20th century, the MPIC has been connected with the names of numerous prominent scientists, including Nobel Laureates Emil

9 For details on the episode in Tailfingen, see the monograph: Lässing, Teufel.

Fischer (1852 – 1919), Richard Willstätter (1872 – 1942), Otto Hahn (1879 – 1968), and Paul Crutzen (born 1933). The range of research topics over the century spans color chemistry and the discovery of nuclear fission, examinations of moon rocks brought back by Apollo 11, research on the chemical composition of the Earth's atmosphere, and finally, investigations of mutual chemical processes in the Earth System as a whole.

As one of the oldest and most renowned non-university research institutions in Germany, the MPIC represents a rich resource for historical scientific research. Until now, however, the historiography has primarily addressed the early history[10]; more recent episodes in the history of the institute and questions about its role in the context of the scientific landscape in the Federal Republic have largely remained unexplored—with the exception of a commemorative publication on the occasion of the one hundredth anniversary, published in 2012 with some contributions that also addressed aspects of more recent times.[11]

Although certainly desirable, a complete presentation of the history of the institute since the foundation of the FRG should not and cannot be presented here. Instead, this study addresses specific aspects of the institute's history, with particular focus on atmospheric chemistry research that was established there at the end of the 1960s and continues today. The current research orientation of the MPIC on broad chemical processes of the Earth System can scarcely be understood without this background. Core fields of research on atmospheric and Earth System have been or are being examined and at times re-explored. The spectrum of research ranges from the exploration of atmospheric trace gases, anthropogenic influences, greenhouse gases and biomass combustion, to theories of nuclear winter, the study and explanation of the ozone hole, and the suggestion of the name "Anthropocene"

10 To name just a few examples: Johnson, Kaiser's Chemists; Kant/Reinhardt, 100 Jahre; Krafft, Im Schatten; Weiss, Beschleunigerlaboratorium; Weiss, The "Minerva" Project.

11 Kant/Reinhardt, 100 Jahre.

for a new geological era. Today, the MPIC plays a major role at the national as well as international level in the exploration of questions relating to environmental chemistry, focusing in particular on the nature, mutual influences and characteristics of the bio-, geo-, atmo-, and anthroposphere. Even a first glimpse at the description of activities taking place within the independent departments located there today clearly demonstrates that the current structure of the institute is based on a principle of complementarity. The common thread that permeates these research activities is that the current departments all deal with cycle's processes present in and between the Earth's spheres, with a particular focus on areas of atmospheric chemistry: the research emphases of the Atmospheric Chemistry Department, headed by Johannes Lelieveld (born 1955), include the development and construction of measuring instruments that detect trace gases in the atmosphere, the identification of photochemical reaction chains, as well the development of model-based computer simulations that describe chemical and meteorological processes.[12] The Particle Chemistry Department (formerly the Department of Cloud Physics and Chemistry) is led by Stephan Borrmann (born 1959) and addresses the chemical constitution and physical characteristics of atmospheric aerosol and cloud particles.[13] The third department established in 2012 and headed by Ulrich Pöschl (born 1969), the Multiphase Chemistry Department, highlights research into chemical reactions and the transport and transformation processes between solids, liquids and gases.[14] Finally, in 2015 the institute established the Climate Geochemistry Department headed by Gerald H. Haug (born 1968), where re-

12 See MPIC website: <https://www.mpic.de/forschung/atmosphaerenchemie.html>, status: May 23, 2018.

13 See ibid., URL: <https://www.mpic.de/forschung/partikelchemie.html>, status: May 23, 2018.

14 See ibid., URL: <https://www.mpic.de/forschung/multiphasenchemie.html>, status: May 23, 2018.

searchers are investigating the interaction of processes that take place between the Earth System's elements: climate, ocean and atmosphere from short annual periods through times of geological relevance.[15]

The foundation for this current structure was laid in 1968 with the appointment of meteorologist Christian Junge (1912-1996) and the associated establishment of atmospheric chemistry at the institute. Even as late as the mid-1960s, the MPIC's topics were far from research questions about the atmosphere or even about Earth Systems. The integration of atmospheric chemistry in 1968 is thus a key event in the history of the institute as well as the history of Earth System Sciences in the MPG in general. It resulted in extensive restructuring lasting for several decades at the MPIC and laid a cornerstone for the development of a scientific field, which has shaped the overall profile of the MPG until today. The detailed history behind this reorganization is the subject of the first part of this article. The development of the MPIC is closely tied to the gradual expansion of atmospheric sciences throughout the FRG since the end of the 1960s and the ultimate development of this field into an independent branch of research in the first half of the 1980s.[16]

Interdisciplinary scientific research has recognized the atmospheric sciences collectively as a highly relevant subject for research for some time. Numerous studies have traced how topics in the atmospheric sciences have made a decisive contribution to scientific, political and public discourse over the past forty years.[17] Furthermore, a majority of the existing literature has considered the development of the atmospheric sciences as an independent science sector since the second half of the 20th century as an international phenomenon, and has focused

15 See ibid., URL: <https://www.mpic.de/forschung/klimageochemie.html>, status: May 23, 2018.

16 See Schützenmeister: Zwischen Problemorientierung, 109 f.

17 See Böschen, Risikogenese; Grundmann, Transnational Environmental Policy; Conway/Oreskes, Merchants.

on the structures and roles of relevant organizations such as the "Intergovernmental Panel on Climate Change" (IPCC) or the "Global Change Research Program".[18] Moreover, a number of historical and philosophical studies of the instruments and methodological repertoire as well as the credibility of atmospheric research have been conducted, above all focusing on climate research.[19] However, much less attention has been placed on the history of organizations and institutions; when attention has been given, there is often particular emphasis on the role of the U. S.[20] The historical appraisal of the atmospheric sciences in the FRG remains largely unexplored, with a few individual exceptions such as studies on the history of meteorological services[21] and the Institute for Physics of the Atmosphere in Oberpfaffenhofen.[22] The MPIC in Mainz so far has remained largely unnoticed in this context, but nevertheless is a particularly suitable subject for research in order to bring to light further information on the development of research on both the atmosphere as well as the Earth System as a whole. The three chapters of this volume deal, chronologically, with the episodes of the institute's history since the late 1950s.

The first part, an internal perspective of the MPG, traces the search for a successor for former MPIC director Josef Mattauch (1895 – 1976) that began at the end of the 1950s with a number of failed attempts.

18 E. g. Kwa, Local Ecologies; Beck, Moving; Leuschner, Glaubwürdigkeit; Uhrqvist/Linnér, Narratives of the Past.

19 Amy Dahan (2013): Historic Overview of Climate Framing, in: HAL Working-papers, URL: <https://halshs.archives-ouvertes.fr/halshs-00855311/document>, June 6, 2018. — Edwards, History; Heymann, Understanding; Heymann, Lumping; Gramelsberger, Conceiving process. See also: Gramelsberger/Feichter, Climate Change.

20 Incl. Hart/Victor, Scientific Elites. — Spencer Weart (2010): The Discovery of Global Warming, URL: <https://history.aip.org/climate/>, October 9, 2018.

21 Wege, Entwicklung.

22 See Achermann, Institutionelle Identität. — See also: Volkert/Achermann, Roots; Achermann, Eroberung.

This search plunged the Chemistry, Physics and Technology Section of the MPG (CPT section) responsible for appointments and the institute itself into a severe crisis in the mid-1960s, but, with numerous detours, finally led to the appointment of meteorologist Christian Junge and the establishment of the Departments for Atmospheric Chemistry and Cosmochemistry. The latter was headed by geochemist and meteorite scientist Heinrich Wänke.

Part two is based on an article[23] published in 2016 and looks at the history of the institute under the leadership of Junge until the end of the 1970s, with particular regard to the role of the Atmospheric Chemistry Department and the DFG Special Research Project 73 "Atmospheric Trace Gases" (SFB 73) which largely characterized that department in the context of the development of the atmospheric sciences within the Federal Republic of Germany. The SFB was the first comprehensive DFG program to address the chemical and physical nature of the Earth's atmosphere in the context of which a new generation of young scientists were specifically trained primarily in the study of the chemical composition of the global atmosphere. Through the 1970s, environmental sciences in general, and thus atmospheric research as a part of this field, became increasingly relevant for political authorities as well. Furthermore, the sense of the crucial importance of anthropogenic influences on material cycles started to gain a foothold in research, continuing to mature into a scientific understanding by the middle of the decade.

Finally, the third part of this book concentrates on the continuation of atmospheric chemistry at the MPIC and the increasing focus on questions relating to Earth Systems under Paul Crutzen (born 1933) and Meinrat O. Andreae (born 1949). This part is divided into two sections. The first section, starting with the late 1970s, addresses the further development of the institute into one oriented on the chemistry of the Earth's systems. The focus of this section is both on central

23 Lax, Aufbau.

research topics (in particular the "CLAW" hypothesis and biomass combustion) and the structural reorganization of the institute at the end of the 1970s as well as the establishment of the Biogeochemistry Department under the leadership of Meinrat O. Andreae in 1987. The second section pursues separately Paul Crutzen's work on anthropological influences on the Earth's climate and the Earth System from the start of his scientific career in the early 1970s (the role of aviation, CFCs), through his time at the MPIC (nuclear winter, the ozone hole) and up to the concepts of the Anthropocene and geoengineering that were significantly shaped by Crutzen after his retirement in 2000.