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Karl Rawer's life and scientific achievements*

B. W. Reinisch

Environmental, Earth and Atmospheric Sciences Department, Center for Atmospheric Research, University of Massachusetts Lowell, 600 Suffolk St., Lowell, MA 01854, USA

*Dedicated to Prof. Dr. K. Rawer on the occasion of his 90th birthday.

Abstract. This laudation is given in honor of the 90th birthday of Prof. Karl Rawer. The ionosphere was discovered during Karl Rawer's life, and he has dedicated his life to the exploration of this part of Earth's environment. The horrible events of world wars I and II shaped his early life, but they also launched his career as one of the eminent geophysical scientists of the twentieth century.

1 Introduction – the early years

"Actually, it was chance and circumstances that gave me the opportunity to participate in the shaping of the research development in ionospheric and space science during the 20th century" so reminisces Karl Rawer, looking back on his life's achievements. From 1913 to 2003, i.e. from pre-WWI to the deplorable war in Iraq, Karl has seen the world change. He was fortunate to learn from eminent physicists and mathematicians during his university years in the 1930s, Gustav Mie and Gustav Dötsch in Freiburg, and Arnold Sommerfeld and Jonathan Zenneck in München. Zenneck had started ionospheric echo sounding experiments in Bavaria and asked Rawer to develop the theory for the reflection of vertically incident radio waves from the ionosphere as his doctoral thesis. Being allowed to use the jewel of the mathematics institute, an electrically driven mechanical calculator, Karl was able to solve this problem in little more than a year. And from here on he was hooked in one way or other to ionospheric research for the next sixty years. During WW II, he became responsible for ionospheric radio predictions, working with Johannes Plendl and Walter Dieminger, and also Ewald Harnischmacher and Klaus Bibl. When in 1945, after the end of WW II, Roy Piggott escorted Dieminger's Radiowave Research Team from its operational base in Austria to Lindau near Göttingen (Niedersachsen) in the British Occupation Zone, Rawer's group followed the invitation by Yves Rocard to establish an ionospheric prediction service in the French Zone. A new ionospheric institute came to life first in Neuershausen, then in Breisach (Baden-Württemberg), i.e. close to Karl's academic origins in Freiburg and to his native Saarland. I first met Professor Rawer in 1960 when he accepted me as a graduate student at the "Ionosphären Institut Breisach". Other graduate students at the time included Rolf Kraft, Jürgen Büchau, Fritz Fischer, Frank Ade, Gerhard Schmitdke, Christian Münter, and Hans Böhnel. A life long friendship connected all of us until today, most of us now retired. Sadly Fritz and Hans died early, and Jürgen, who together with me emigrated from Germany to the USA, died 10 years ago. Rawer's institute gave me my first opportunity to see real scientist and researchers in action: Ewald Harnischmacher, Klaus Bibl, Rudolf Eyfrig, Hannes Hesse, Adolf Paul, Klaus Jacobs. Karl Rawer was born to lead and he did so by inspiring his coworkers and students, and by training young scientists from around the world.

On his way from Austria to Baden-Württemberg, Karl and his family had stayed for a short while in Bayern, the native state of his wife Waltraut. Of the seven children, their son Bernhard is here today to witness the ceremony in honor of his father. An unfortunate accident has hospitalized Mrs. Rawer preventing her from accompanying Karl to Miltenberg, as planned. Waltraut Rawer has made it possible for Karl to achieve successful balance between a happy family life and an extraordinary career.

2 International outreach

Building international "research bridges" out of Germany was Karl's most important objective in the post war years, and international cooperation became the leitmotiv in his career. For many years he made weekly trips from Breisach to Paris to lecture at the Sorbonne University as a Professeur Associé, in collaboration with his friend Etienne Vassy. International travel in the early sixties was not as convenient as it is today and we students had great respect for Professor

Correspondence to: B. W. Reinisch
(Bodo_Reinisch@uml.edu)

Rawer's strenuous schedule and of course his international recognition. I might have been even more impressed would I have known about another Associé lecturing at the Sorbonne at the same time, Robert Oppenheimer, but I learned about it only later. Rawer's URSI activities began in 1954, and he represented the German ionospheric research in the preparation of the International Geophysical Year, 1957/1958. By that time, ionospheric sounding was done in many countries around the world, but there were no common rules for the scaling and interpretation of the ionograms, making global studies difficult. Eight ionospheric experts joined and formed the Worldwide Sounding Committee under the leadership of the American Allen Shapley, Rawer among them. Roy Piggott and Karl Rawer published the results of the committee's work as a Handbook for the Scaling of Ionograms. At the URSI General Assembly in Munich in 1966, Rawer was elected international Vice-Chair of what is today commission G of URSI, and served as Vice-Chair and then Chair until 1972.

Starting in the early 1950s, his institute developed scientific payloads for the newly developed French rocket "Veronique" for a first successful launch in 1954 in the French Sahara. His space experience and the connections to international research groups made Prof. Rawer the natural choice to take a leading role in the West-German National Committee of COSPAR. After the death of Julius Bartels in 1964, Rawer became its chairman. He vigorously exploited the opportunity that COSPAR offered to establish long lasting relationships between scientists from west and east across the cold war borders, but also with researchers in India and in hitherto neglected countries in the Far East and Africa.

Better writers than I are required to fully describe the impact of Karl's visionary activity on ionosphere and space research in the 20^{th} century. As his former student and an early beneficiary of his leadership I am merely listing a few highpoints that have impressed many in my generation. In 1953 he published the first book on the ionosphere, appropriately called *Die Ionosphäre,* which was later translated into English. Although by inclination an experimentalist, he was a master of describing and documenting new results and in sorting existing knowledge, as he did in a series of handbooks. Jointly with Kurt Suchy he wrote *Radio Observations of the Ionosphere,* published in 1967 as Volume III/II in the Geophysics Series of the Handbuch der Physik. After Bartels's death in 1964, Karl Rawer became the editor of the series and issued the next five volumes of the series, III/III to III/VII. I leave it to the historians to count the huge number of his scientific and science policy papers; I guess there must be several hundred.

In the early 1970s, the Space Science Committee in COSPAR decided to develop a "Standard Ionosphere Model". Again the choice was clear who should lead this effort. Karl Rawer took on the challenge, mandated by COSPAR and later URSI, and so in 1975 began the odyssey of the International Reference Ionosphere, IRI. In the next talk, Dieter Bilitza will report on Karl Rawer and the IRI.

3 Rawer's institutes

Under most difficult post war conditions an ionospheric vertical incidence sounding station came to life in 1946 at Schloss Neuershausen, near Freiburg, under the auspices of the French Service Prévision Ionosphérique de la Marine (SPIM). This was the beginning of a long cooperation between French and German ionospheric prediction studies. Rawer then managed to establish the "Ionosphären Institut" in Breisach under the administrative control of the German Postal Service. This institute gained international reputation in the field of ionospheric radio wave propagation and instrumentation through its cooperation with research organizations in the USA and France, and joint measurement campaigns in Italy, Greece, and Norway.

To complement the remote sensing with radio waves by observations with space borne instrumentation, the Fraunhofer Society authorized Rawer to found a separate institute on Kronenstrasse in Freiburg, the Arbeitsgruppe für Weltraumforschung, with project funding from the Deutsche Forschungsgemeinschaft, NASA, and the European Space Agency ESRO. The launch of two successful satellite missions with instrumentation from the Arbeitsgruppe, AEROS in 1972 and AEROS-B in 1974, led to temperature and ion composition data that became an important input to the International Reference Ionosphere. Soon the building on Kronenstrasse became too small to house the expanding space research activities, and the Fraunhofer Society built an expansive institute in Freiburg-West. Karl Rawer was appointed the director of this Institute for Measuring Techniques, leading it until his retirement in the late seventies.

4 Conclusions

The IRI Working Group felt honored in organizing this special session at the German National URSI Meeting 2003 as a laudation to Professor Rawer's life and career. As chairman of IRI, I wish to thank the German National Committee of URSI for integrating this session into the Kleinheubach URSI program, and the Copernicus Gesellschaft for today's special arrangements.

Karl, I feel happy about this opportunity to thank you publicly for what you have done for geoscience, and for your leadership that affected so many of us assembled here today. The large international audience attending this special session bears witness to your high standing as a scientist and as a human being. We all wish you a happy 90th birthday and good health for the next decade.