

Personal reflections about Richard R. Ernst (August 14, 1933 – June 4, 2021), one of the great scientific minds of our time



Photograph: copyright Matthias Ernst, Zürich

It is with great sadness that we mourn the recent passing of Richard R. Ernst, who is a founder of modern NMR spectroscopy. As most readers will know, during his active career from the 1960s to 1990s, Richard Ernst made seminal contributions to the development and applications of Fourier transform NMR, two-dimensional NMR, and MRI propelling these techniques into the mainstream of chemistry, biology, and medicine. His many contributions were recognized, among others, with the 1991 Nobel Prize in Chemistry.

I had the unique opportunity to closely work with Richard Ernst from the mid-1980s to the late 1990s at the Laboratorium für Physikalische Chemie at ETH Zürich, Switzerland, first as his graduate student and later, upon returning from a postdoc in the U.S., as a junior research faculty in the role of Oberassistent and later Privatdozent supervising his lab's solution NMR research.

For the purpose of this bulletin, I have been asked to share some of my own personal observations and recollections of my interactions with Richard Ernst, which are taken mostly from my time when I was a graduate student in his lab. Over the past week, much has been written about Richard Ernst's vast scientific legacy, which will not be recounted here. Instead, I hope that those who personally knew him will be able to relate to some of my accounts with their own personal reminiscences and those who mostly (or only) knew him through his work can get a better glimpse of this fascinating, multifaceted personality.

Richard Ernst was a scientist extraordinaire whose down-to-earth attitude and lifestyle was in sharp contrast to his brilliant mind. He possessed the rare combination of supreme skills in applied math, physics, chemistry, and electrical engineering, which he put to use to create revolutionary new NMR methods with lasting impact. Above all, Richard Ernst had the perhaps rarest of all gifts,

namely an abundance of common sense paired with curiosity and a natural instinct to identify scientific problems that were intellectually stimulating, had a good chance of success, and had at least some potential to be practically useful - if not immediately, perhaps sometime in the future. The latter requirement was particularly pertinent to his view of the proper role of basic research in society, which he often stressed to his group members and in his public lectures. In later years, Richard Ernst described to me the sometimes heavy responsibility he felt throughout his career to live up to the expectations he set for himself to justify his privileged position as a professor at ETH endowed with almost boundless academic freedom. It meant for him both pressure and motivation. Paired with his gift for science and a healthy ambition, it created a uniquely powerful combination to pursue research at the highest level for decades.

From early on in his lab, I learned that Richard Ernst was always good for a little surprise. One evening, as a 1st year graduate student, I was preparing the final figures for my first manuscript with him. This was at a time when computer graphics were still uncommon and figures were annotated with peel-off letters and templates. For a key figure I needed a template for some special geometric symbols and I went to Richard Ernst's office asking for his advice. He took a peek, pulled out a black ink pen from his drawer and, to my astonishment (and his visible amusement), he quickly, and nearly perfectly, drew the symbols by hand directly in the figure. The figure, due to its "personal touch", remains one of my favorites.

Deliberations were Richard Ernst's element. Meetings with him in his office F28 on the F-floor of the CHN building at ETH Zentrum, behind a 5-inch soundproof ETH office door, were legendary. The meetings were either one-on-one or with a small group of coworkers. More than four people were almost impossible to fit in his office, also because of large piles of books, folders, and scientific papers on his desk, windowsills, and sometimes even on the floor, but always neatly organized. It was not uncommon that these meetings would last for hours without breaks. However, the meetings would be interspersed with pauses of pin drop silence that could last for minutes during which Richard Ernst went into a deep, almost meditative thinking mode, similar to a chess player who tries to think through all conceivable variations from the middle game all the way to the endgame or a composer who tries to make a complex chord progression work. Unsurprisingly, these pauses could be slightly awkward, especially for new lab members who were wondering what was going on and didn't know how to react. Some international coworkers even speculated it may be a typical "Swiss thing" (it wasn't). I don't know what went through his mind during these pauses (I never asked), but over time I came to realize that disrupting the silence usually led to a nice, but rather superficial conversation, whereas meetings with pauses that remained uninterrupted were usually the ones that ended with a productive conclusion, such as the proper design or interpretation of an experiment.

Richard Ernst created in his group a research environment and culture that lifted the coworkers in its orbit to a higher level. He led by example with long working hours in his office, usually from 7:30 am to 7:30 pm Monday through Friday and sometimes shorter stints on Saturdays. During a period when I

worked in the lab almost around the clock (while writing my Ph.D. thesis and, at the same time, finishing up manuscripts and working against a deadline for a postdoctoral fellowship application from the Schweizerischer Nationalfonds), Richard Ernst passed one evening by my desk and started a conversation, as usual in his Swiss German dialect, which was from his native town of Winterthur (it slightly differed from mine from my hometown of Rüti, even though they are only 20 miles apart). Before leaving, he noted with a slight grin: "Herr Brüschwiler, jetzt schaffet sie so viel wie ich." ("Mr. Brüsweiler, you are now working as much as I do.") This was his highest level of praise. As a side, only later he would address his coworkers (and vice versa) with the more casual "du" instead of "sie".

Richard Ernst was similarly inspiring as a lecturer and teacher as he was as a researcher. In his many invited seminars he took on the role of a science ambassador for people across the globe, often accompanied by his wife Magdalena. His wit, open-mindedness, and generosity left a lasting impression on many audiences. He had the rare ability to explain even highly complex scientific concepts with simple, visually relatable pictures that allowed diverse audiences appreciate the power of NMR as well as the importance of science at large. Long before the advent of LCD projectors and powerpoint presentations, he manually prepared with artistic flair and at stupendous speed overhead transparencies for his lectures that included multiple layers of foldable transparencies that gave viewers the illusion of short animations. He avoided mathematical equations and unnecessary text at almost all cost in order not to lose anyone in the audience. His presentations did hardly ever finish early and were peppered with observations about the human nature. One of his memorable slides started innocently with a 2D NMR spectrum, for which he then drew analogies, cross-peak by cross-peak, with the various relationships possible between a group of (adult) individuals. All of a sudden, everyone in the audience understood two-dimensional NMR - some even thought they were already experts. The audience loved it and some attendees mentioned the lecture to me for quite some time.

In contrast to his public lectures, in his graduate courses and group seminars he did not shy away from going all the way to the bottom of a theory or a physical-chemical effect. He developed, in great mathematical detail and with unique didactical skills, rigorous formalisms, often in quantum-mechanical Liouville space, in order to accurately capture all nuances of a given phenomenon. His ability to quickly switch between qualitative vector pictures of spin magnetization to mathematically rigorous quantum treatments was not only a pedagogical tool, it also allowed him to simultaneously capture the essence of NMR phenomena from very complementary viewpoints leading to better insights and new research ideas.

Richard Ernst's favorite form of communication was perhaps in writing, allowing him to pursue his penchant for perfection. It also allowed him to frame with "microscopic" precision the results of scientific inquiry as an enduring truth the way he understood it. It was not uncommon that research manuscripts had 50 (and sometimes many more) versions often involving major revisions between

iterations. Richard Ernst always started out from a paper printout of the latest manuscript version from which he cut with his long pair of tailor scissors the parts that were worth keeping (which often was not a whole lot), glued them on sheets from an ETH paper pad and linked them with new handwritten text along with comments. The resulting “patchwork”, which was to become the official new manuscript version, turned out to be almost unrecognizable from the previous version, not seldom to the consternation of the co-authors who had thought they were (finally) done. Not so fast...

During the manuscript (re)writing process, Richard Ernst was at the same time also the most critical judge imaginable who tried to uncover any hidden flaw or inconsistency, thereby continuously, and often substantially, improving the quality of the work. Hours of discussions starting during the daily group coffee breaks, which were always attended by the entire lab, and continuing in his office, could be spent about how to best define for a manuscript in progress a new convention or nomenclature that guaranteed to stand the test of time. What ultimately ended up as a very naturally flowing, easy-to-read paper was the result of hard work underpinned by much thought and deliberation that casual readers would barely realize, which was precisely Richard Ernst’s goal. Only when he “had it” with a particular manuscript, he declared it ready for submission to the designated journal. At least, the effort that went into the manuscript writing did not go unnoticed with reviewers, who often had, if any, only minor comments. For my first JACS communication I still remember a particularly succinct review that consisted of a single word, typed with a typewriter on the pink reviewer sheet: “Publish.”

Although Richard Ernst officially retired in 1998, it is still early to fully comprehend his legacy. In both his thinking and work, he was a pioneer who was often far ahead of his time. He, for sure, ranks at the pinnacle of Swiss scientists among the likes of Felix Bloch, Wolfgang Pauli, and even Albert Einstein.

For those who did not have the fortune to get to know Richard Ernst in person, a fitting comparison with another larger-than-life Swiss personality is perhaps Roger Federer. They both achieved in their chosen professions extraordinary success displaying enormous willpower with unparalleled elegance, while sharing an often humorous, down-to-earth personality inspiring people from all walks of life.

For me personally, it was a privilege of a lifetime to work closely with Richard Ernst on many different and exciting research projects and to get to know him well both as a scientist and as a person. He was for me the perfect boss allowing me much intellectual freedom while always willing to listen and offering advice when needed. The many interactions with him, as well as with the large number of outstanding coworkers he was able to attract to his lab, shaped me and my thinking in important ways to this day for which I am truly grateful. After leaving Zürich, it has always been one of my goals to convey some of the spirit I was able to experience in Richard Ernst’s lab to the graduate students and postdocs in my own research group.

I once gave a seminar at an international pharmaceutical company followed by a tour of the NMR facility. A senior NMR scientist, who was close to

retirement, came up to me and said: "I am so indebted to Richard Ernst. He doesn't know me, but without him I would not have had this wonderful job and a career." He spoke for many of us. Some time later, I mentioned it to Richard Ernst. He did not comment and seemed almost embarrassed. He shrugged his shoulders with a quick smile on his face, like the one on the picture, before he left. A graduate student was waiting in his office.

On June 4, 2021, I lost together with many others a dear mentor and colleague and the global scientific community lost one of the great scientific minds of our time. The world also lost a kind and sincere human being.

Rafael Brüsweiler June 14, 2021