Viewpoint:
Interdisciplinary research to address societal issues

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Anyone who knows René Schwarzenbach realizes that he is passionate about environmental science. This is reflected in his long and productive academic career. But René's impressive output of peer-reviewed publications does not reveal his equally-passionate interest in the societal relevance of science. This has been a strong motivation both for his interdisciplinary research and his work in outreach to stakeholders, practitioners and the public.

In 1977, René returned to Switzerland after his postdoctoral stay at the Woods Hole Oceanographic Institution (WHOI) in Massachusetts and joined the Swiss Federal Institute of Aquatic Science and Technology (Eawag). He soon began work on a field study of volatile halogenated compounds in Lake Zurich (see figure). This project illustrated that substantial insight could be gained from simple models and that physical processes can exert important controls on contaminant concentrations in the water column (see the contribution by D. Imboden in this issue).¹

René continued his problem-oriented field studies as a member and, from 1985-1987, as Head of Eawag's Department of Multidisciplinary Lake Research in Kastanienbaum, near Luzern. During this time, he participated in interdisciplinary studies of the transport of organic contaminants from river water to groundwater² in the much-studied Glatt River (located near Eawag's main laboratory in Dübendorf, outside Zurich).

René's work on contaminant fate and transport in Lake Zurich and the Glatt River provided evidence that domestic sewage effluent is an important source of micropollutants to both surface- and groundwater. In 1983, René and co-authors Werner Stumm and Laura Sigg wrote an article recommending that "all substances that are mass-produced and may become dispersed into the environment because they are being used in households, small trades, and agriculture (e.g., detergents, cleaning fluids, agrochemicals) have a satisfactory biodegradability".³ The authors further "...encourage[d] chemists to participate in the solution of ecotoxicological problems...".

During this period, René was also engaged in teaching in the post-graduate program (German acronym NDS) in urban water management and water protection at the ETH Zurich. This program

served as the basis for later curriculum development in the ETH Department of Environmental Sciences (see the contribution from B. Wehrli in this issue).

We take the liberty here of fast-forwarding over an important period in René's career, when as Professor at ETH and Head of the Department of Environmental Sciences, he made many of the major contributions for which he is best known in academic circles. From 2000-2005, he also played a leadership role at Eawag as a member of the Directorate, promoting interdisciplinary projects and the integration of social sciences with natural sciences and engineering. During this time, he also co-edited the book "Who Owns the Water?" (Lars Müller Publishers), which targeted a broad audience and was released in 2006.

Here we focus on René's contributions to a novel program within the ETH Domain,⁴ the Competence Center Environment and Sustainability (CCES). The CCES began its activities in January 2006 with funding from the ETH Domain. This internal funding was intended to allow the CCES to address complex research questions requiring the engagement of large, interdisciplinary research teams and potentially benefiting from cooperation within the ETH Domain. The CCES had four overarching goals: (1) to achieve a visible societal impact with a focus on socio-economic implementation, (2) to establish the CCES partners as an international and national focal point for environmental and sustainability, (3) to achieve a long-term structuring effect lasting beyond the completion of the CCES, and (4) to establish a strong education and outreach program.

As might be imagined, it was no easy task to transform the CCES concept (approved by the ETH Board in December 2004) into a full-fledged program. This required the engagement of highly-motivated colleagues to stimulate broad interest in CCES and the development of a portfolio of innovative, interdisciplinary projects with societal relevance. Key roles were played by René, as Chair of the CCES Steering Board, Prof. Domenico Giardini, as the first CCES Director, and the 16 members of the CCES Management Committee leading to the successful launch of CCES in 2006. In addition to chairing the Steering Board, René took on the Director's responsibilities in 2009.

From 2006 to 2012, the CCES grew to include 176 principal and co-investigators whose projects produced 148 Ph.D. theses and 364 Master's theses. This led to many new and productive collaborations spanning disciplinary and institutional boundaries. Students had the unconventional experience of working in large teams on interdisciplinary projects with substantial engagement with practitioners and stakeholders. Nearly 200 courses, seminars and workshops were held for stakeholders outside the scientific community and about an equal number of publications were produced that targeted this audience. Curricula based on CCES projects for use at the secondary school level and an intensive block course, "Science Meets Practice", were developed. The block course not only trained Ph.D. students and postdocs to communicate with stakeholders but provided the opportunity to work with stakeholders in addressing issues such as the Swiss energy transition.

Although the science generated in the CCES projects is judged by conventional scientific standards, the impact of CCES was intended to extend well beyond the academic sphere and to lead to the implementation of measures to increase sustainability within society. The achievement of this ambitious and unconventional goal is extremely difficult to evaluate, particularly in the short-term.⁵ This highlights the tension between the application of conventional academic metrics and the potential benefits to society of promoting interdisciplinary, problem-oriented research.

René continues, as an emeritus professor, to chair the CCES Steering Board. The CCES is a unique mechanism to channel curiosity-driven research into areas, like sustainability, that are sorely needed by society but are not responsive to market forces because they deal mainly with public goods. More generally, CCES addresses the questions, near to René's heart, of how to promote policy-relevant science and how to train scientists to pursue such research and engage in policy debates. We have no doubt that René himself will continue to promote this discussion in the academic community.

Stuart Wakeham (left) and René Schwarzenbach (right) collecting samples on Lake Zurich in the late 1970's for the study published in ref. 1.

References

- (1) Schwarzenbach, R. P., Molnar-Kubica, E., Giger, W. and Wakeham, S. G. (1979) Distribution, Residence Time, and Fluxes of Tetrachloroethylene and 1,4-Dichlorobenzene in Lake Zurich, Switzerland. *Environ. Sci. Technol.* **13**: 1367-1373.
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- (4) The ETH Domain consists of two technical universities in Zurich and Lausanne (ETH Zurich and EPFL) and four federal research institutes, of which Eawag is one. Oversight and strategic planning for the Domain is the responsibility of the ETH Board. See:
http://www.ethrat.ch/sites/default/files/ETHR_RB11_inKuerze_E_120427_0.pdf
- (5) Hering, J. G., Hoffmann, S., Meierhofer, R., Schmid, M. and Peter, A. (2012) Assessing the societal benefits of applied research and expert consulting in water science and technology. *GAIA*, **21**(2): 95-101.