

A PERSONAL RETROSPECTIVE: FROM BAYREUTH TO CAIRNS.

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From my perspective as a public health physician with an interest in chemicals and health, dioxins were of minor personal or professional concern until 1982. Then, working full time as professor of preventive medicine and part time as a county health department director in Binghamton, New York I became involved with an office building filled with PCBs, dibenzofurans and dioxins following an electrical system fire which involved an indoor "PCB" transformer. The transformer was filled with PCBs and chlorinated benzenes some of which changed to dibenzofurans and dibenzodioxins as Buser and Rappe had previously shown in laboratory experiments could occur in the presence of heat and oxygen. Smoke vents and staircases produced a distribution of soot containing these chemicals contaminating the entire building. This included walls, floors, file cabinets, office desks and chairs and equipment on each floor of the building. The question of human exposure and potential adverse health effects was of great concern to the workers, the general public and government officials. PCBs were rapidly identified in indoor air by an industrial hygienist/chemist and Steve Hamilton, a senior environmental specialist, from General Electric Company (GE). Later, dibenzofurans and dioxins were measured in dust and soot throughout the building by the help of Professor Thomas Tiernan and the New York State Health Department dioxin chemists Patrick O'Keefe and Robert Smith.

Discovering the contamination of an entire 18 story office building, shutting it down for many years as it turned out, and beginning adipose tissue and blood analyses for dioxins and dibenzofurans as well as PCBs on some workers interested Otto Hutzinger, the founder of the International Dioxin conferences. He invited—and paid all expenses, one time only!—for me to attend and present at my first Dioxin conference, in Salzburg if my memory is correct. This was the first trip to Europe for this unsophisticated, then younger American scientist and I was fascinated by the vastly different culture I encountered. Taking hours for coffee or meals at restaurants, for example, and not being rushed out to be replaced by the next customers; what an odd but pleasant cultural change.

Tom Tiernan at Wright State University analyzed cleanup workers' fat tissue and blood and reported dibenzofurans and dioxins, not only TCDD, in both tissues. To the best of my knowledge, this may have been the first human blood as well as fat tissue analyses. Some workers were found to have elevated levels of certain congeners measured in dust or soot from the contaminated building. But all persons tested had a number of furans and dioxins. This was quite surprising to us. Many of us naively thought of dioxins primarily with respect to Agent Orange in Vietnam. The contaminated building took 13 years and a reported \$52,000,000 dollars for cleanup and reentry. It might have been less expensive to have taken it to a toxic waste dump and to have used other downtown buildings or construct a replacement building. Later, CDC chemists headed by Larry Needham and Don Patterson with Wayman Turner and also as Chris Rappe's group in Umea, Sweden also reported a number of dioxins and dibenzofurans in the general populations they studied and helped move the field of dioxin analysis forward with improved methods. The availability of dioxin standards and better instruments improved sensitivity and specificity..

At many of these dioxin meetings, Peter Fuerst from Germany and Jake Ryan from Health Canada presented dioxin levels from large numbers of human milk samples, reporting dioxins and dibenzofurans and later also added dioxin like PCBs to their analyses.

Later, research with Vietnamese scientists and physicians produced documentation of TCDD's persistence decades after Agent Orange was sprayed in some persons, wildlife, food and environmental samples which was documented by Olaf Paepke, Jake Ryan, Kees Olie, Seppo Raisenin, Peter Fuerst, Rainer Mailisch, and others. These were usually first reported at these dioxin conferences. In those pre 9-11 days, transport of specimens frequently involved simply packing human specimens with ice, blue ice, or dry ice. (9-11 interrupted our otherwise excellent Dioxin meeting in Korea organized by Jae-Ho Yang and presented difficulty in finding flights back to our homes.)Dry ice was frequently donated by airlines which used it to keep ice for beverages cold. This was carried in a plastic picnic container in the cabin of the airplane. Unfortunately for our research and sense of drama, this is of course no longer possible. The finding of elevated TCDD in some locations only and in some soil (1,000,000 + ppt of TCDD in Bien Hoa City area near the airfield (and up to 400+ ppt in blood from the same area)evidently resulted from food still contaminated with TCDD decades after Agent Orange was sprayed, frequently from spills of Agent Orange where stored in Vietnam.

At WHO meetings we learned of laboratories which had frequently moved forward from using fat tissue to milk or blood to estimate dioxin body burden or exposure. Some chemists then required 400 mL of blood for measurement of PCDD/Fs. Now we have PCDD/F/DL-PCBs measured with 10-20 mL in some cases (when all goes well in the lab and levels are high enough). My own dioxin levels were measured from a 100 gm fat tissue sample, obtained with a scalpel and a local anesthetic.

Workers and sometimes even workers spouses sometimes showed elevated TCDD or PCDFs decades after exposure, whether these were some US Air Force sprayers of Agent Orange, an American chemist who had synthesized TCDD and also TBDD and who was hospitalized for a short time because of acute symptoms, and others. Others included municipal incinerator workers in Japan, workers in the Binghamton, NY office building, British workers, German chemical company workers (over 35 years after that work ended), some Soviet Union or Russian workers and others near a large chemical plant, Khimprom, in Ufa near the Ural Mountains and also in Siberia. (In Russia, Jake Ryan was without doubt the most enthusiastic singer and dancer and followed by Linda Birnbaum who was more noted as a singer than a dancer (compared to Jake)). Olaf and Linda and I presented several seminars in Israel and Palestinian areas, brought home carved wood camels from Bethlehem and on one occasion I brought back breast milk and food to document levels in Israelis and Palestinian Arabs. The findings were usually presented at these dioxin meetings and then published for many years in the special Dioxin issues of Chemosphere which Otto Hutzinger edited, assisted by Heidi Fiedler.

In more recent years as interest in dioxins declined, other new (to me) chemicals came to be of interest. These were sometimes known as Persistent Organic Pollutants or POPs and sometimes Endocrine Disruptors or EDs. Dioxins, of course, are both.

Brominated flame retardants like PBDEs became household words after Karen Noren and colleagues from Stockholm reported marked increase in Swedish human milk of PBDEs at the same time dioxins and dioxin like compounds levels were decreasing. Olaf had analyzed some U.S. specimens from Texas and found very high PBDE levels. He and I at first thought perhaps this was from the Dell Computer company in Texas near where the samples were collected. We then analyzed general population women's milk in Texas and found US women's PBDE levels orders of magnitude higher compared to European levels. We later found blood PBDE levels with similar elevations and with a similar congener pattern with certain differences: larger molecules were at lower levels in milk than in blood.

With Jake Ryan, we compared Canadian to US human milk and found PBDE's high in both countries but slightly higher in US milk. However, we found HBCD at low levels in both countries and the levels similar to what had been reported from Europe. We are now moving forward from these studies and hope to present findings from the National Children's Study in the United States at next year's dioxin meeting with PBDE and BPA findings in mothers and their infants.

Over the past few years we, like others, reported levels of POPs in food and in human tissue. These included PBDE's beginning with US fetal tissue finding lower levels than in adults. HBCDs and their stereoisomers in US food were reported with Olaf the first time, phthalates in US food were also measured for the first time and we plan to present the finding sat this meeting. Collaborators included Olaf Paepke and Kurunthachalam Kannan. BPA was of interest to us especially in canned food and BPA in mothers and infants is part of our work with the US National Children's Study which hopefully will be presented next year at this meeting along with our PBDE findings.

Most enjoyable, other than becoming a worldwide tourist and scientist, has been a friendship of so many chemists, colleagues and spouses. In Japan and at these meetings Prof. and Mrs. Masuda and my wife, Martha Jean, became acquainted and I had the very pleasant opportunity of staying with the Masudas in their home on several occasions. In Japan there was an unexpected pleasure of eating American style barbecue in Fukuoka with Yungi Nagayama and his family. Olaf and Ingrid Paepke and my wife and I became friends and stayed in one another's homes. Charlotte and Jake Ryan feared I was going to die in their home after one very exhausting Vietnam trip. Other Vietnamese scientists stayed with my family in Binghamton New York and in later in Dallas Texas; these include Dr. Le Cao Dai, Dr. Hong Trong Quynh, and Dr. Nguyen Ngoc Thi Phuong.

Earlier this year in Vietnam my wife and I added faculty at the Hanoi School of Public Health as colleagues and friends. Long ago, we stayed at the University of Helsinki Guest House as guests of Seppo Raisanen and were treated to another new culture. Chris Rappe, who never ceased to electrify, surprise and get us used to his wonderful informal Swedish ways, introduced many of us to more herring than we ever imagined existed, and more Aquavit than we could handle-not having quite the body reservoirs of Chris. Gunilla, Brent and others, like the newer generation including Ake Bergman and Andreas Sjodin and other brilliant Swedish chemists introduced many of us to new chemicals and new issues, especially brominated flame retardants. Arlene Blum, with her amazing enthusiasm and energy presented a perspective on flame retardants that was new to many of us. Linda Birnbaum overwhelmed us with her knowledge, enthusiasm and speaking ability. Larry Needham was a role model for many of us and is irreplaceable in the US with his gentle and diplomatic manner, wisdom, unthreatening approach to people and knowledge of chemistry. Doris Needham added to his reputation and obvious great judgement. We did not know which of the two was more personable. Larry did of course have one flaw: he was addicted to a strange game known as golf. Don Patterson, who worked with Larry, introduced us to improved chemical method, his realization that with economic uncertainty and without the threat of bankruptcy, one should never fully retire. Don and Deborah became a fixture at these conferences. We Americans learned of the enormous talent to be found among Swedish and German scientists and also other Scandinavian scientists and we also learned of brilliant scientists from Japan, China and Korea. Thus, these meetings not only helped moved chemistry forward along with improving public health but also brought us into contact with a wonderful group of people many of whom became friends for life.