

Brian Conway Remembered

by Barry R. MacDougall



BRIAN CONWAY

When I was asked to write a retrospective on the life and career of **BRIAN E. CONWAY**, I thought a lot about what it was that made Brian a truly unique figure in the field of physical electrochemistry. Besides the obvious fact that he was a very major force in advancing the field during his nearly 60-year career, I realized that it was due at least in part to his equally strong contributions to both the “electrodics” and “ionics” sides of electrochemistry. [For those not familiar with these

terms, the former refers to heterogeneous processes occurring at the interface between the solid electrode and the solution, while the latter deals with mainly homogeneous phases and ions in solution.] Both are critical for electrochemistry, and Brian was a master in both areas over all those years. This is something that is rarely, if ever, the case today (and was even unusual in the field when Brian started in 1946). As one of his former students from the electrodics side of the house about 40 years ago, I can personally attest to Brian’s being one-of-a-kind in the physical sciences, and a master at devising ways to understand why things happen in solution and at electrodes during electrochemical processes (and utilize that knowledge and understanding). To provide that picture, I will follow Brian’s scientific career from its beginnings in the mid-40s to his last accomplishments in mid-2005. I will use personal stories of Brian-the-person (garnered from many of his colleagues, as well as his wife Nina Conway and close colleague Halina Kozlowski, both of whom still live in Ottawa),

along with the many important contributions he made to the field of electrochemical science and technology.

Conway began his career at Imperial College, London University, in the group of John O’M. Bockris (recently deceased) in 1946 at age 21. That early research with Bockris led to seven major publications, dealing mainly with electrocatalysis of the hydrogen evolution reaction (HER) on different metals, and the role of solution and surface impurities on the kinetics and mechanism of the reaction. While it is probably hard to believe these days, not that much was known about the detailed kinetics and mechanism of such processes ~ 70 years ago. John considered Brian to be a superlative physical electrochemist (in his own words), and had immense respect for his mind and wisdom. During my years at University of Ottawa (U of O), Bockris visited Brian on many occasions for stimulating, in-depth scientific discussions as well as reminiscing about British culture and values (Brian would confide to us), something I found hard to understand as a young student from Nova Scotia. They spent a lot of time working on *Modern Aspects of Electrochemistry*, as well as joint papers and projects; I always thought that John loved being in Ottawa, and having direct scientific exchanges with Brian. It must have been hard to put-up with John sometimes, but Brian was always able to handle it with grace and style.



The “Gang” at Imperial College, London, 1947/48, with **B. CONWAY** in the front row, second from right; **J. BOCKRIS**, **R. PARSONS**, **M. FLEISCHMANN**, **H. ROSENBERG** are also present.

Before leaving Brian's early career days at Imperial College, I want to cite the considerable influence of the very first Discussions of the Faraday Society, held in London in 1947, on the 22 year-old BEC. He was able to attend with John and others from the Imperial group, and met J. A. V. Butler there; as well, he was exposed for the first time to the work of the famous group of Russian electrochemists. That group included A. N. Frumkin, B. V. Ershler, B. Levich, P. Dolin, B. Kabanov, and others. During the depression years of the 1930s and then WW 2, the west had little access to the cutting-edge research in electrochemistry being conducted in the USSR, so this meeting was an important one, and for Brian it took place at the start of his very long career in the field. Others at that meeting included N. F. Mott, A. Hickling, J. J. Lingane, T. P. Hoar, J. E. B. Randles, W. F. K. Wynne-Jones, J. Heyrovský, to name but a few. For Brian, it must have been incredible to have been there.

After obtaining his PhD at Imperial, Brian joined the Chester Beatty Cancer Research Institute in London, staying from 1949 to 1954 as a staff member. There he worked with the famous J. A. V. Butler (of Butler-Volmer equation fame). His research with Butler, whom he admired and respected greatly as a gentleman and scholar, concerned in part the influence of electrochemically-generated free radicals and ionizing radiation on DNA-type species in the body, with a view to assisting in the treatment of certain cancers. While this is in no way my area of expertise, I would imagine that using valid electrochemical phenomena to fight cancer-causing cells was quite novel 60+ years ago. I have the feeling that his years with Butler (and the associated 15+ publications in respected journals) had a profound influence on Brian, and helped set-the-stage for his long, distinguished career in electrochemistry.

In 1954, Bockris convinced Brian to leave his mother country for the possibly greener shores of America, where John had taken up a position at the University of Pennsylvania in 1953; Brian joined him as a PDF and stayed for 2 years. During that time, a number of very significant research papers were published by the two, covering subjects like the mechanism and kinetics of proton transfer in solution, the HER on different metals taking into consideration the M-H bond strengths and the metal d-band characters, and the detailed mechanism of metal deposition processes themselves. Those were active, fruitful years for both of them, and set-the-stage for the next major move in Brian's career. This revolved around an invitation from the University of Ottawa, via Prof. K. J. Laidler, who saw the need for a strong school of electrochemistry at U of O. The invitation was accepted, and Brian remained there for the subsequent 49 years of his career.

Brian's research record at the U of O shows the breadth and depth of his accomplishments, covering electroductics and ionics, polymer thermodynamics, high and low temperature work, fundamental and industrial research, environmental and energy research, *etc.* To this day, I am amazed by the scope of his research, and the fact that he clearly understood in detail all aspects of the work carried out over the decades in his laboratory and by his researchers. He knew all aspects of his reported research that appeared in papers, book chapters, books, reports, conference presentations and proceedings, *etc.*; indeed, this was a source of great pride for Brian. He was a superlative research director and teacher who was always available to his students and collaborators; he had no sense of time-for-himself – his life was his work and electrochemistry. Students like myself of course did not realize how lucky we were at the time this was happening. This however became quite clear to us as the years passed. Those U of O

years can be divided into 4 distinct periods, namely 1956-1966, 1967-1978, 1979-1989, and 1990-2005. I will now give just a few highlights from these different periods to illustrate the contribution and impact of BEC at U of O, which resulted in nearly 450 publications.

Conway's initial 10 years at U of O, 1957-1966, were an active period in numerous wide-ranging areas of electrochemistry, including the Kolbe reaction, battery materials and processes, identifying pseudo-capacitance as related to electrode surface coverage, polymer thermodynamics, ion hydration/electrostriction/other ionic issues, H/D separation factors, adsorption of organics, *etc.* Brian produced ~80 papers during the period, working with students like Gileadi, Kozlowski, Gilroy, Vijn, Barradas, Salomon, Marincic, Rudd, and many others. I believe that Conway was fortunate in being able to attract such talented students worldwide in this early period in Canada, and it helped cement his reputation as a pre-eminent physical electrochemist in Canada and abroad.

In the second phase, 1967-1978, Brian's research expanded to include fuel cell processes, oscillatory kinetics, partial molal volumes, compressibility of salts, ellipsometry, RDE at high temperatures, *etc.* Co-workers like Gottesfeld, Wojtowiaz, Perkins, Sattar, Currie, LaLiberte were but a few during that period. About 114 publications



A. N. FRUMKIN and a young B. E. CONWAY in Frumkin's Lab, Moscow, 1950s.

resulted from that very productive decade for Brian. The next 2 phases from 1979 to 2005 resulted in an additional 250 publications in such areas as electrochemical supercapacitors (on which Brian wrote a classic reference book), temperature dependence of both the Tafel slope "b" and the symmetry factor beta, electrosorption valency of anions and its influence on surface oxidation, the fluorine and chlorine evolution reactions, ion hydration in the double-layer, single crystal and alloy electrodes, and many more. Indeed, Conway's range and depth of subjects covered continued to be vast until the end of his life; he never did slow down. In these last two phases, dozens of researchers worked with Brian and I can obviously only name a few: Tilak, Harrington, Wilkinson, Birss, Tessier, Bai, Liu, Mozota, Barnett, Hamelin. A complete listing of all the students, colleagues and co-authors who worked with Brian over his almost 60-year career is simply outside the scope of this article.

What I personally remember from my PhD years in Brian's laboratory was his enormous "discussion" ability with all those who worked with him, which I understand pervaded all of his 49 years at U of O. His knowledge, memory and powers of reasoning were legendary

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in the scientific community, as all who interacted with him will know. On a more personal side, he expected his students to be at work on Saturday, and Sunday if possible; he was certainly there on both days if he was in town. In those long-gone days we students were only too pleased to be present since he had time to meet and discuss with us. It was a time when he was free from his many weekly administrative and teaching duties, and Brian was free to “let his hair down” and show us just what a superlative glassblower he was. Indeed, he could have easily been a “master glassblower” if he had had the time needed to devote to it; he loved the challenge of forming complex internal seals with, *e.g.*, Luggin capillaries. With pieces of thin glass shavings in his hair, Brian would discuss scientific and research issues with his students who stood and admired his glassblowing abilities. Lunch at Brian’s favorite local restaurants (Chinese or Italian) over the weekend was anticipated by us students, and more in-depth scientific discussions ensued. I’m certain that none of us realized all

those years ago how fortunate we were to have a supervisor/mentor like Brian Conway, who was always more concerned with the desire for understanding and knowledge than he was with himself. That era produced some of the giants of electrochemistry; besides Conway, a few I personally recall are: Uhlig, Hackermann, Tobias, Kruger, Pourbaix, Gerisher, Bruce Wagner, Newman, Heller, Yeager, Rapp, Alkire, Hashimoto, Epelboin. Like Conway himself, many of these trailblazers had very strong associations with ECS over very long periods of time, and in many capacities.

Conway received scores of awards and honors during his long distinguished scientific career. Two in particular were very important for him, both ECS Society awards. The first was the Henry B. Linford Teaching Award in 1984; indeed, Brian is the only Canadian to have so far received this award. Secondly, the Olin Palladium Award in 1989; I know that he was very proud to be included with such other recipients as Carl Wagner, U. R. Evans, A. N. Frumkin and A. J. Bard. Only one other Canadian, the late Morris Cohen of NRC, has received this award during its 65-year existence. Those, and many other awards and honors from numerous societies, never inflated Brian’s ego or changed his openness and willingness to discuss science and technology with anyone. He was always a down-to-earth person driven by an insatiable curiosity and desire to understand and explain



BRIAN CONWAY in his laboratory in the 1990s sitting in front of a SEM with X-ray analysis capabilities.

scientific phenomena and observations. Conway was a complete scientist and professor (teacher) in the truest sense of the words. My only “mild” criticism of Brian and his approach was that he sometimes understated and downplayed his very considerable achievements and scientific abilities. He always showed a lot of self-restraint in making low-key scientific statements regarding what he considered should be obvious to everyone in the field. Conway was always a gentleman and scholar, whose ego never interfered with his strong desire to further the understanding and appreciation of science, in particular electrochemistry. I found him to be something of a rare individual indeed, and The Electrochemical Society (and electrochemistry itself) were most fortunate to have had such a person as one-of-their-own for the second half of the last century, and a bit beyond. ■

About the Author

BARRY R. MACDOUGALL completed his PhD with B. E. Conway in 1972, and remained in close touch with him during the next 33 years (both being in Ottawa). MacDougall was President of ECS in 2007/2008, and became an adjunct Professor at the University of Ottawa in 2006. He continues to give what were previously Conway’s graduate courses at the University.