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## Obituary: Prof. John O'Mara Bockris (1923–2013)

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"Few can attain this man's knowledge, and few practise his virtues, but all may suffer his calamity. Of the uncertainties of our present state, the most dreadful and alarming is the uncertain continuance of reason."

Samuel Johnson, *Rasselas*.



*John O'Mara Bockris (1923–2013)*

Bernhardt Patrick John O'Mara Bockris (born 5 January 1923, in Johannesburg, South Africa, died 7 July 2013, in Gainesville, Florida) was one of the central figures of mid-twentieth century electrochemistry, a gifted teacher, and redoubtable controversialist.

During his long lifetime, he strove heroically to achieve two related goals. The first was to carry out fundamental research in areas of contemporary intellectual importance. The

second was to systematize broad areas of physical and environmental science. Among his vast output were notable contributions in high temperature electrochemistry, double layer theory, electrocrystallization, photoelectrochemistry, quantum electrochemistry, and much else besides. His work rate was prodigious, and by the time of his death he had authored or co-authored over 600 research papers and more than 20 books. In his heyday (the nineteen sixties) he was among the top ten most cited physical chemists in the world. His best work always conformed to a rigorous pattern - a clear historical summary; an exacting mathematical formulation of the hypothesis being tested; and finally an *experimentum crucis*. His research ethos was unsentimental and uncompromising, and he never wavered in his belief that good data were better than bad theory.

To many observers, John Bockris appeared "typically British", but this was somewhat illusory. In fact, he was an outsider in the 1930s British culture in which he grew up. A Catholic, a colonial, and a sufferer from childhood scoliosis (which prevented regular participation in sports), he received his early education at a series of rather ordinary schools on the English south coast. However, a turning point came with his entrance into Xaverian College, Brighton, during the years 1937-1940. The Xaverian Brothers imbued the young man with the great virtues of intellectual rigour and social responsibility, and these twin pillars of thought remained with him for the rest of his life. He also attained a fluency in German, having learned the language during summer holidays with his father in Germany.

In 1940, he transferred to Brighton Technical College where he studied for a general degree in Mathematics, Physics, and Chemistry. Having mastered Latin at school, he added Old High German (Althochdeutsch) to his linguistic skills. In that era, Brighton Technical College was affiliated with Imperial College, London, and in 1943 Bockris was able to transfer into their PhD programme under the supervision of Harold J.T. Ellingham. Despite war-time conditions, and living in a hostel, his PhD thesis, "Electrochemistry of Non-aqueous Solutions", was completed within two years. He avoided conscription into the British Armed Forces by virtue of his South African nationality. In 1945 he was recommended for a faculty position by the renowned Harry J. Emeléus. He was still only 22.

After the war, Bockris diversified his interests into double layer theory, electrode kinetics, and the electrochemical behaviour of silicates at high temperature (2000 C). Among his students were Roger Parsons and Brian E. Conway. However, the UK was painfully slow to recover from the Second World War, and many "austerity measures" (including food rationing) continued until 1953. These vexations severely handicapped scientific research, so when Bockris was invited to be a visiting professor at the University of Pennsylvania in 1953, he readily accepted. Within a year, his position was made permanent. He was joined there by Brian Conway, who became a lasting friend. With Conway he developed much of his later thinking on the hydrogen evolution reaction, which he treated as the prototype for all other electrochemical reactions. Conway also triggered his lifelong fascination with the oxygen reduction reaction.

During the nineteen fifties, massive infusions of federal funding had made the University of Pennsylvania a major research centre. Thanks to this largesse, Bockris was able to expand his research group, and soon began to attract talent from far and wide. Among many notable collaborators were Wolfgang Mehl, C. Austen Angell, Erik A. Blomgren, Alexander Damjanović, Boris D. Cahan, and Aleksandar Despić. The Pennsylvania years culminated in a remarkable burst of creativity in the mid-nineteen sixties. In 1963 Bockris published his most celebrated paper, called "On the Structure of Charged Interfaces". This was co-authored with Michael A. V. Devanathan and Klaus Müller. The paper was published in the Proceedings of the Royal Society (London), and today is widely referred to as "The BDM Paper". It was the first time that the structure of water on an electrode was included in any model of the double layer, and it is still required reading for young electrochemists today. Shortly afterwards, Amulya K.N. Reddy joined the Bockris group, and together they wrote the now-classic textbook *Modern Electrochemistry*.

Internal politics at the University of Pennsylvania eventually led to disenchantment, however, and in 1972 Bockris took a leap into the unknown by accepting the position of Professor of Physical Chemistry at the (then) recently-opened Flinders University of South Australia. Conditions in Adelaide were physically challenging (no air-conditioning in the Australian summer heat!), funds were short, and the remoteness from the United States, Europe and Japan meant that it was hard to maintain personal contact with world-leading researchers. Nevertheless, the local conditions inspired two new interests – solar energy and the hydrogen economy – which were later to galvanize a whole new generation of electrochemists. Bockris also began a series of classic experiments with Kohei Uosaki on the photoelectrochemical generation of hydrogen.

Over time, the stress of commuting back and forth to the northern hemisphere became too much, and Bockris resigned his position in 1978. He returned to the USA to take up an appointment at Texas A&M University as a Professor of Chemistry (later as a Distinguished Professor) but he was never able to recapture his earlier success. As the nineteen eighties progressed, he focused more and more on energy-related topics, but a decline in his mental powers was becoming noticeable. In 1989 he even supported the claim of "electrochemically induced nuclear fusion of deuterium" by M. Fleischmann, B. S. Pons and M. Hawkins, which caught the public's imagination, but which was disproved within a few months. By that time, however, he had become inured to criticism, and refused to recant. His reputation never recovered. Thereafter, he gradually assumed the role of a counter-cultural figure, and began to make increasingly audacious claims regarding the transmutation of the chemical elements, to the dismay of many of his old colleagues. After a prolonged series of University inquiries into his research, and a diagnosis of cancer, he finally retired from Texas A&M University in 1997. In his retirement, Bockris remained in College Station, Texas, for seven more years, before finally moving to Gainesville, Florida. The death of his wife, Lillian, in 2005 was the penultimate blow. He died on 7th July 2013.

John Bockris operated at the centre of physical chemistry for more than 50 years. His great achievement was that he uncovered the buried landscape of electrochemical history, used it to guide the creation of modern, relevant, textbooks, and taught the subject to two generations of students. His division of electrochemical science into “ionics” and “electrodics” reflected the great post-war developments in electrode kinetics, and remains useful today. He knew all the leading electrochemists of the past half century, and considered the entire subject as his purlieu. He was socially cosmopolitan, a polymath, and a fearless debater. At the height of his powers he argued with Frumkin about the double layer, with Gerischer about photoelectrochemistry, and with Fleischmann about nucleation. But none of this was critically unbalanced or personally vindictive. His admiration for Frumkin was genuine and oft-repeated. He regarded Gerischer as the leading physical electrochemist in Europe, and he remained friendly with Fleischmann to the end. His mental decline after 1989 should not cloud anyone’s assessment of his earlier achievements.

During his long career, Bockris received surprisingly few major awards. Notable exceptions were the Breyer Medal of the Royal Australian Chemical Institute (1972), the Faraday Medal of the Royal Society of Chemistry (1981), and the Henry B. Linford Award for Distinguished Teaching, granted by the Electrochemical Society in 1994. His lasting monument, however, is surely his great textbook, *Modern Electrochemistry*, which can still be read for pleasure and profit forty years after its first publication.