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Robert (Robin) Harold Stokes 1918–2016

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Robin Stokes was born in the village of Southsea, on Portsea Island, UK, on 24 December 1918 and died in Armidale, NSW, Australia, on 15 November 2016. He came from a long line of distinguished scientists and mathematicians. Robin was educated at Auckland Grammar School, Auckland University College and the University of Cambridge. He commenced his academic career at the University of Western Australia in 1945 during the post-war reconstruction period, left there to pursue his PhD at Cambridge in 1947 and returned as a senior lecturer in 1950. He took the chair of chemistry at the University of New England in 1955 and remained there for the rest of his career. He made outstanding contributions to our understanding of electrolyte solutions. His book with R. A. Robinson has more than 12,000 citations.

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Family background

Robert Harold (Robin) Stokes was born in the village of Southsea, on Portsea Island, UK, on 24 December 1918. His mother was in the village waiting for her husband to be demobilised from the army after the First World War. He had an elder brother, John, and a younger sister, Margaret (Peggy). Robin came from a long line of mathematicians, scientists and engineers on both sides of his family.[1] 'The Stokes family is one of the most remarkable Irish intellectual dynasties and it has a long association with this College'. So said Professor Davis Coakley at the start of his 1996 Trinity Monday Discourse at Trinity College, Dublin, Ireland.[2]

Robin's father was John Whitley Gabriel Stokes, a civil engineer. Robin's earliest traceable ancestor on this side of his family was John Stokes, 'a Taylor within the White Lyon, Dublin.' His son, Gabriel, born in 1682, was the Deputy-Surveyor-General of Ireland and a noted mathematical instrument maker. Two of Gabriel's sons, John (born 1716) and Gabriel (born 1726), were professors of mathematics at Trinity College, Dublin. Other members of this remarkable family were Sir George Gabriel Stokes, of the Navier-Stokes equations and William Stokes, an Irish physician, the Stokes of the Cheyne-Stokes respiration. Cheyne-Stokes respiration is an abnormal respiration pattern that results in cessation of breathing (apnea).

In a letter to his family sent from England in 1958, Robin commented: 'The conclusions are evident-the whole damn lot of us are nothing but a bunch of Irish mathematicians. The chemistry of course comes from my mother's side…', and indeed, it did!

Robin's mother was Margaret Raeburn Slater. Her father, Harold Humbolt Slater (1856–1937) was a chemist employed by the Thames Cement Works in Grays, Essex. He became a Fellow of the Institute of Chemistry of Great Britain and Ireland on 15 March 1888.[3] Harold's father, John William Slater (also known as Julian Wilfred Slater) was an analytical chemist, wholesale dealer and manufacturer of chemicals. He was the author of *Handbook of Chemical Analysis for Practical Men*, published in 1861.[4] He was styled 'Professor of Practical and Analytical Chemistry'. Under the name Julian Wilfred Slater, he issued a notice of intention to proceed with a patent: 'An improved metallic compound applicable to the manufacture of various useful articles' on 24 August 1857 with Samuel Fox (the inventor of the metal framed umbrella).[5] Using the name John William Slater, he was also the co-inventor of a series of patents to do with sewage treatment in the 1870s.

Robin's father met his mother in Argentina where he was surveying railways. His mother was travelling with her parents, who were there on business. John proposed to Margaret in London in 1916 while he was on leave from the war. Post war, there was little public money available for new engineering projects, and after a few years farming, John Stokes and his young family migrated to New Zealand in 1924.

Robin's family lived in the small town of Murchison in the South Island where his father, a civil engineer employed by the New Zealand Government, was surveying for a railway intended to go from Nelson across the mountains to the West Coast. In 1928, the family moved to Hobsonville, near Auckland where his father was the site engineer for the New Zealand Air Force base being built at Hobsonville. Robin and his older brother went to the primary school at Hobsonville, where Robin describes the headmaster as being 'clinically insane'. The children were eventually sent into Auckland to the

[1] Marsh (2009*a*). Professor Ken Marsh interviewed Professor Robin Stokes for the Australian Academy of Science on 23 April 2009. Quotes are from the transcript of this interview.
[2] Coakley (1996).
[3] Anon. (1895) p. 67.
[4] Slater (1870).
[5] Fox and Slater (1857).

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Wellesley Street primary school. Robin's father lost his job during the Depression and bought a small dairy farm near Hobsonville.

According to Peggy Stokes (later Peace), her elder brother, John, had to leave school after two years at Auckland Technical Institute to help on the farm, and resented it, but:

> Robin, who was a brilliant student, had gained a national scholarship which enabled him to attend Auckland Boys' Grammar School. Teased and bullied because of his total lack of interest in sports, he took refuge in the chemistry laboratory, where he enjoyed working as lab assistant for all the time he was not in the classroom. In this way, he developed the single-minded passion for science that was to be the foundation of a distinguished academic career. At home he would pore for hours over the massive volumes of the *Encyclopedia Britannica* (the highly regarded eleventh edition), sifting laboriously through the scientific entries. When not reading he was occupied in the shed, which he had set up as a laboratory with, shelves of equipment and chemicals. For him the farm simply did not exist.[6]

Robin met Jean Mary Wilson in 1939 while attending Auckland University College. They married in 1942. Robin described the romance:

> Yes. Well, she was a year behind me in the university entrance; nevertheless, with the way the syllabus was organised, we had some classes that we both went to. I very quickly realised that she was a great rarity—somebody who had the same sort of interests as me and the same general outlook on life, and it was just encountering a kindred spirit.

Jean Wilson was a daughter of Colin and Martha Wilson, who were farmers. A student at Epsom Girls' Grammar School in Auckland, Jean won a University National Scholarship in 1937. She graduated MSc with first class honours in chemistry in 1942. During her undergraduate years, she worked with natural products chemist, Professor Lindsay H. Briggs, and with physical chemist, Robert A. Robinson, publishing four papers under her maiden name, including the synthesis of 4,5 methylenedioxychrysene in 1941.[7] All her subsequent papers were on electrochemistry. She published her last paper in 1965.[8]

Robin and Jean had three daughters, Helen, Anne and Jennifer.

Secondary education

At the completion of his primary school education, Robin received a scholarship to Auckland Grammar School (a government secondary school). He did well at school, always coming in the top group in nationwide exams. He avoided sport and military drills by taking a job as a 'laboratory boy'.

His interest in photography developed in those years, as he recalled:

> My father had an old folding camera. This was a very nice Kodak f.8-folding camera with a particularly good lens, and I had a lot of fun taking photographs with that. I didn't have a proper darkroom at home but I was very small and I used to climb up a stepladder into the top cupboard in the wardrobe and develop my films in there, it was quite a good darkroom. Later on, I set up enlarging facilities and things in my bedroom, which I just used at night when one didn't have to worry about too much light getting in.

Tertiary education

In 1935, Robin was awarded the Gillies Scholarship to study physics and chemistry at the then Auckland University College. He found that he had won the scholarship from reading the newspaper.[9] This also informed him that it was awarded on the proviso that he was born in New Zealand. As the newspaper article stated,

> The Gillies Scholarship in chemistry and physics was provisionally awarded to R. H. Stokes, of Henderson. It was stated that the candidate's application stated that he had not been born in New Zealand, as the conditions of the scholarship required. The council decided that if the candidate's statement on the point was verified the scholarship should be awarded to the proxime accessit, K. D. George of Rotorua.

The scholarship was, accordingly, awarded to George, who went on to gain a degree in physics and had a distinguished career in Department of Scientific and Industrial Research (DSIR).

At school, Robin was very good at languages and had to decide whether to study science or arts at university. He decided on science because his rival for supremacy at school, who typically obtained one or two percent higher marks than Robin, was going to study languages, so would not be a competitor in science! This rival was Murray William Speight, who went on to be the 1940 New Zealand Rhodes Scholar. He died tragically in World War 2.[10]

Robin commenced his BSc degree at the Auckland University College, University of New Zealand in 1936 and completed the degree in 1938. The results were announced on 1 February 1939 when the examiners' results were received by cable from England and Australia.

Robin went on to do an MSc (First Class Honours in Chemistry) awarded 1940 and a Diploma of Honours (Second Class Honours in Mathematics) awarded 1941 at Auckland.

Collaboration with R. A. Robinson

When Robin enrolled at the Auckland University College in 1936, there were three permanent chemistry staff.[11] The professor was Frederick Palliser Worsley, an Auckland graduate with a DSc from Imperial College London, Lindsay Heathcote Briggs, another Auckland graduate who had studied organic chemistry under Robert Robinson at Oxford, and a young physical chemist. The physical chemist was Robert A. Robinson, a graduate of the University of Birmingham (BSc, MSc and PhD), who had worked with Herbert S. Harned at the University of Pennsylvania and Yale University.

Despite the lack of facilities in 1933, Robinson immediately commenced his research program. One of the outcomes of his early work was the development of the isopiestic vapour pressure method for the study of the thermodynamics of electrolytes. In 1939, he began a collaboration with Stokes as part of Stokes' MSc studies.

[6] Private communication to authors from Peggy Peace née Stokes, via Stokes' daughter Helen.
[7] Briggs and Wilson (1941).
[8] Hepler, Stokes and Stokes (1965).
[9] Anon. (1935).
[10] Anon (1945).
[11] Cambie and Davis (1983), p. 43.

Their first paper was part 1 in a series of 17 papers in the *Transactions of the Faraday Society*.[12] Robin was the author or co-author of parts 1, 6, 7, 8, 10, 15, 16 and 17. Jean Wilson was the co-author of parts 3 and 10.[13] These collaborations were interrupted by the outbreak of World War 2, but continued by correspondence after the war, and culminated in the monograph *Electrolyte Solutions* published in 1955, with further editions in 1959 and 1970.[14]

As Stokes remarked in the 2002 Dover edition of the famous book:

> The first edition (1955) of Electrolyte Solutions was written while I was in Perth (Western Australia), which had an excellent airmail service to Singapore [where Robinson was then located]. We decided to confine ourselves mainly to topics on which we had first-hand experience, and to include all the numerical data we were continually looking up in the course of our research work, as well as tabulations of reliable fundamental data on electrolytes. This seems to have met a need, and the book in its subsequent editions continues to be widely cited. It was the subject of a Current Contents Citation Classic in 1988, when long out of print. Why not produce a completely new version rather than the present reprint of the 1970 revision? It would require several volumes to do justice to huge expansion of the field in recent decades, particularly in the area of solutions in non-aqueous solvents. Aqueous solutions at high temperatures and pressures have also received much attention, and there have been major theoretical advances. We are content to have played a part in laying foundations and drawing attention to gaps in knowledge. It should be noted that all values quoted are in pre-SI units, see the 'Preface to Reprinted Edition' (p. v) and the 'Table of Important Constants' (p. xv) for details. I thank Dover Publications for making our work available again for students and research workers. There is still no substitute for measured facts.

By 27 August 2018 the book had 12,070 citations, including 218 in 2017![15]

World War 2

The New Zealand Government, led by Prime Minister Peter Fraser reluctantly introduced conscription in June 1940, we write 'reluctantly' because Fraser had spent one year in jail for sedition during World War 1 for speaking out against conscription.

At the end of 1940, Robin's number came up in the ballot and he was duly sworn in to the army. He immediately went to work in the Colonial Ammunition Co. in Auckland. An ammunition manufacturer, this company was established in Auckland, New Zealand with government encouragement in 1885 during the Russian Scare, as Whitney and Sons. Whitney recruited shareholders from a cartridge company in Leeds and it was linked to the ammunition company of the same name in Melbourne.

As Robin explained: 'They were doing almost entirely metal forming work, drawing brass cartridges and the various shaping operations needed for those and assembling the bullets with the lead cores.' He learnt a lot about metallography and became quite skilled at polishing metal surfaces and etching them to see the crystal structure. He also came to appreciate the contribution of the skilled technicians to the success of the operation. The factory moved to Hamilton in 1942 to protect it from a Japanese invasion but Robin returned to Auckland for weekends.

Robin married Jean Wilson in 1942. She was a full-time, but temporary, lecturer in physical chemistry at Auckland University College, replacing R. A. Robinson who had gone to Canada on war work. They gave each other a Marchant hand calculator for a wedding present. Robin noted that 'Some people thought it was a bit eccentric'.

University of Western Australia

Robin applied for the position of lecturer in chemistry at the University of Western Australia on 1 October 1945 and was appointed on 22 November. He commenced duties on 1 February 1946. The position was for the three years of the post-war reconstruction period.

The Department of Chemistry at the University of Western Australia was quite small. In 1944, there were only two members, Professor Noel S. Bayliss and Dr George A. Elliot, both physical chemists. In 1945, Noel Riggs was appointed a temporary lecturer in organic chemistry and Douglas Elwood White the lecturer in charge of organic chemistry.

Prior to the appointment of Bayliss in 1938, research was not encouraged in the department. Bayliss took delivery of a Hilger E3 medium quartz spectrograph in 1939, but it was not used until after the Second World War. Elliott did not build a research program, although he had made a promising start at University College London with his work on the kinetics of chemical reactions in electric discharges.[16] Bayliss, his students and colleagues, had made an extremely valuable contribution to the war effort through the alunite project, which produced potash and alumina from an alunite (hydrated aluminium potassium sulphate) deposit near Merredin.

The staff were obviously delighted when Stokes joined the department as a 27-year-old with a well-established research record. Immediately they enrolled him as an Associate of the Australian Chemical Institute (ACI, later RACI) and nominated him for the Rennie Memorial Medal (awarded in 1946). The Western Australian Branch of the ACI was, as Robin noted, 'emboldened' by the Rennie success to nominate him for the Meldola Prize of the Royal Institute of Chemistry in London (awarded to a British born chemist under the age of 32). The application was successful and he won the 1946 medal jointly with the organic chemist, A. W. Johnson. This was the first award of the Meldola Medal to someone outside the British Isles.

Robin and Jean used the opportunity of a Robin's three-year appointment to develop their work on evaluating the activity coefficients of electrolytes. In a further contribution to Robin's career, the Western Australian Branch of the ACI brought to Robin's attention the fact that Imperial Chemical Industries was offering fellowships to do post-graduate studies in England. He was

[12] Robinson and Stokes (1940).
[13] Robinson and Wilson (1940).
[14] Robinson and Stokes (1955).
[15] https://scholar.google.com.au/scholar?hl=en&as_sdt=0%2C5&q=stokes+rh&btnG=, accessed 27 August 2018.
[16] Elliott (1928).

successful in this application, so he resigned from the university in October 1947 to take up a fellowship at Cambridge. He, Jean and their (then) two children left by ship to England, arriving in Cambridge just after Christmas 1947. Robin reflected that:

> one of the reasons for this success was that I'd had a bit over a year in Auckland, before the war started, to do some more research after Honours. I had also managed to fit in bits and pieces in Auckland during the war, for part of the time, so I had quite a few publications; whereas most of my contemporaries, in England particularly, had been very much involved in war work and hadn't got any time for publications. So I was, in that sense, just very lucky, and that luck seems to have been with me a good deal of my life actually.

Or perhaps his experience is yet another example of the old adage 'diligence is the mother of good fortune'.[17]

University of Cambridge

One of Robin's antecedents, Sir George Gabriel Stokes (of the Navier-Stokes equation) had been Master of Pembroke College (from 12 August 1902 until his death at the age of 83 on 1 February 1903). Robin was welcomed by the college 'with open arms' even though he could not live in the College because of family commitments.

Robin spent the first few months at Cambridge finishing some calculations (using the wedding present) in connection with his work in Perth. The calculating machine 'made a tremendous impression: here was a man who actually had his own calculating machine'. He decided that diffusion in liquids would be an interesting field in which to work. As he recalled:

> Diffusion in liquids is very closely connected with two of my other interests, which were the thermodynamic properties of solutions and electrical conductivity. The difference between diffusion and conduction in an electrolyte solution is that in diffusion the ions are all moving one way from a concentrated solution to a dilute solution, whereas in conduction, of course, positive ions move one way and negative ions the other.

Robin saw the need for more data on diffusion and developed the stirred diaphragm cell method.

His PhD supervisor was John Agar who introduced the idea of a magnetic stirrer. Robin published two papers from his PhD work and these are two of his ten most highly cited papers.[18]

University of Western Australia again

Robin returned to Perth in 1950 as a senior lecturer in physical chemistry. The Senate Minutes of 19 September 1949 recorded:

> The Vice-Chancellor referred to an attachment to this report setting out the qualifications of applicants for the lectureship in Physical and Inorganic Chemistry. He said that the committee had not been appointed on this occasion to consider the applications, but the Head of the Department of Chemistry strongly recommended the appointment of Mr R. H. Stokes who was previously on the staff of the Chemistry Department before going to England for further study.

Robin took up his appointment as senior lecturer on 1 February 1950. His PhD from Cambridge was conferred on 22 April 1950.

In his Australian Academy of Science interview Robin said: 'Western Australia still didn't have a PhD course, so I had no PhD students, but I had some very good students for the BSc with honours'.[19] In fact the University of Western Australia had commenced its PhD a few years earlier in 1948.[20] The first such degree was awarded to Warwick Bottomley for a thesis titled, 'The chemistry of Western Australian plants'.

Robin's 'very good students' included E. P. Purser, P. J. Dunlop, J. R. Hall, B. F. Wishaw, B. R. Hammond, G. T. A. Müller, B. J. Steel and J. F. Chambers, who also worked with him as an Electrolytic Zinc Research Fellow. Steel went with Robin to the University of New England where he obtained his PhD. Dunlop went to the University of Wisconsin for his PhD and had a distinguished career at the University of Adelaide. Hall went to the University of Washington and then to ICIANZ where Chambers was already working. Hammond went to Cambridge and then back to the Perth Technical College and Müller did her PhD with A. R. H. Cole at UWA. Stokes won the RACI's H. G. Smith Memorial Medal in 1953 at the age of 35 and was promoted to reader on 29 December of that year.

As mentioned earlier, it was during this period that Robin worked with his old mentor, R. A. Robinson, on *Electrolyte Solutions, the Measurement and Interpretation of Conductance, Chemical Potential, and Diffusion in Solutions of Simple Electrolytes*. The book was published in 1955 just before Robin left Perth for Armidale.

University of New England

Noel Riggs, a graduate of the University of Adelaide, was appointed a temporary lecturer in organic chemistry at the University of Western Australia in time for the 1945 academic year. He was awarded a CSIR studentship in 1946 to do his PhD at Cambridge, in Alexander Todd's group, and then worked for CSIRO in Fishermans Bend for a short while before accepting a lectureship at the New England University College in 1952. The College became the University of New England (UNE) in 1954. The chair of chemistry was in the first round of professorial advertisements but the university made no appointment. Riggs suggested that the university encourage Robin, his former University of Western Australia colleague, to apply for the position. Robin was successful and took up the position in 1955.

The UNE Department of Chemistry in 1955 was similar in size to the UWA Department of 1945. Including Stokes, there were five academic staff, three organic and two physical-inorganic. Stokes had the task of building a new department. One of his innovations, on becoming the Foundation Professor of Chemistry, was to negotiate a visiting reader position to be used to invite distinguished physical chemists for periods up to one year. Robin's international reputation for studies on the thermodynamic and transport properties of electrolytes and nonelectrolytes attracted visitors including

[17] de Cervantes (1605).
[18] Stokes (1950*a*). Stokes (1950*b*).
[19] Marsh (2009*a*).
[20] Alexander (1963) p. 444.

Figure 1. Photograph of Robin and Jean Stokes provided by David Rand (photographer unknown).

J. N. Agar, J. E. Prue, R. A. Robinson, L. G. Hepler, R. J. Bearman, R. L. Scott, J. B. Ott, R. Battino, J. S. Rowlinson, M. L. McGlashan, A. G. Williamson and F. Kohler.

In 1978 Robin and Jean were in a car accident near Dorrigo. Tony Gregson, who was a reader in the Department of Chemistry and later a CSIRO board member, recalled:

> they took him to hospital, gave him some X-rays and his whole lung was black. Because he smoked like a chimney, 'You've got lung cancer.' I remember he called us into his office, all the staff, and he said, 'Well, this is it, chaps. I reckon I've got a couple of months to live. And Ken Marsh, I want you to do this, and Tony, I want you to do this, and John, he rattled off all the things we had to do. He said, 'That's it.' We all walked out thinking, 'Bloody hell!' You know. The guy's going to be dead in a couple of months. Well, step forward 30 or 40 years—no, sorry, then they discovered that it wasn't cancer after all, it was just a collapsed lung, which gave up this crazy black image. So he lived on for another 40 or 50 years.[21]

Royal Australian Chemical Institute

Robin was admitted as a member of the ACI in June 1946 but not elected a Fellow until 1993. This seems surprising given his early achievements with the Rennie Memorial Medal in 1946 and the H. G. Smith Memorial Medal in 1953. Nevertheless, an application by the candidate, rather than nomination by other Fellows of the Institute, was required for consideration of a candidate for Fellowship, and for whatever reason it seems that Stokes did not apply until the early 1990s. He was, however, an active participant of two specialist Divisions created in the (then) RACI.

The First Australian Conference on Electrochemistry was held in Sydney (13–15 February) and Hobart (18–20 February) 1963. This was a pre-requisite conference for the formation of the Electrochemistry Division in 1966. Robin was the chair of one of the Sydney sessions 'Thermodynamics of Electrolytes' and gave the chairman's address: 'Thermodynamics of Electrolytes in Multi-Component Systems'. He commenced the address in typically strong fashion:

> The literature of physical chemistry contains a vast amount of information about thermodynamics and transport properties of electrolytes; nearly all of it however refers to single electrolytes in a single solvent, usually water. On the other hand, applied electrochemistry is predominantly concerned with multi-component solutions, and when we want to know some quite simple property such as the activity coefficient of a nickel ion in a 1 : 1 supporting electrolyte, we usually have to guess it. To one as preoccupied as I am with precise measurement, this is a most unsatisfactory situation, and in this review I propose to discuss the various methods by which thermodynamic data for electrolytes can be determined in three component systems.[22]

While Jean is not a co-author of the paper, Robin commented in two places—'Mrs Stokes and I have worked with the cell…'—and again at the end—'Mrs Stokes and I have found …'—thus indirectly acknowledging her contribution to his work (Fig. 1). The conference program reflected the gender balance of Australian science in 1963. There were 168 'conferees', all male. The University of New South Wales Wives' Group organised a comprehensive Ladies Program, including a fashion parade and a visit to the Opera House that was then under construction ten years before its opening in 1973.

The Committee of the Electrochemistry Division of the RACI is responsible for deciding the recipient of the R. H. Stokes Medal,

[21] Spurling and Healy (2017).
[22] Stokes (1965).

awarded for distinguished research in the field of electrochemistry carried out mainly in Australasia. Past recipients include R. H. Stokes, R. Mills, R. Woods, Alan M. Bond, B. Welch, I. M. Ritchie, Stephen Fletcher, Gordon Wallace, and David Rand. Nominations should provide an assessment of the nominee's work and list relevant publications. The nominee must consent in writing to the nomination. The Committee reserves the right not to make an award. While an active participant in Electrochemistry Division events, Robin was never an office bearer of the division.

In the early 1970s, physical chemists around the country (including one of the current authors) decided that it was time to form the RACI Physical Chemistry Division. The group included Dr K. N. Marsh, then at the University of New England. Ken Marsh persuaded Robin to be the interim chairman of the proposed new division. At the time, a division had to have one successful national meeting before it was officially established. This was held in Perth as part of the 45th ANZAAS meeting in August 1973. The second meeting, (after which the division was formed) was at the 5th National Convention in Canberra in May 1974. Dr Reginald Mills took over as Chairman after the Canberra meeting. The divisional committee did ask Robin if he would permit the new division to award the Robin Stokes Memorial Medal. He declined because he 'wasn't dead yet!'

Overall contributions to knowledge

Robin Stokes devoted his scientific career to the accurate measurement and interpretation of the equilibrium and transport properties of electrolyte and nonelectrolyte solutions. His 90th birthday in 2008 provided opportunities for the international community to recognise his contributions to physical chemistry. The *Journal of Chemical and Engineering Data* had its first *Festschrift* issue in honour of him,[23] and the *Journal of Solution Chemistry* had an editorial in recognition of his birthday.[24] The following summary draws upon both of these articles.

Stokes commenced his research career refining and using the isopiestic vapour-pressure method for the determination of water activities and osmotic coefficients and, using the Gibbs-Duhem equation, the mean activity coefficients of aqueous electrolytes. In 1947, he advocated the $CaCl_2$(aq) and H_2SO_4(aq) as isopiestic reference standards for high concentration measurements and resolved inconsistencies between EMF and water vapour pressure data and isopiestic measurements for H_2SO_4(aq) that led to a reference standard based on water pressure data and isopiestic measurements relative to NaOH(aq). As noted by Rard and Palmer, his current assessed values of osmotic coefficients for various electrolytes seldom differ by more than a few tenths of a percent from those reported by Robin.[25] As well as the isopiestic measurements, Robin made significant contributions to many other aspects of the physical chemistry of electrolyte solutions. These include EMF measurements, transference numbers, diffusion coefficients and electrical conductances. The diffusion coefficient measurements were commenced in his PhD work on the development of the magnetically-stirred diaphragm cell.

After his move to Armidale in 1966, Robin developed a greater interest in the measurement and interpretation of excess thermodynamic properties of mixtures of non-electrolyte organic liquids. His PhD student and later colleague, Professor Ken Marsh was his principal collaborator in this work.

Australian Academy of Science

Robin was elected a Fellow of the Australian Academy of Science in 1957 at the relatively young age of 37. He served as a member of the council, 1964–5.

Post-retirement activities

Robin retired as Professor of Chemistry at the University of New England in 1979 at the age of 61. He 'didn't want to be a senior administrator or somebody writing the history of science'. He continued to work on electrochemistry for another ten years publishing one or two papers a year until 1990. He stopped doing chemistry altogether and 'went on with other activities like electronics and my computer and playing chess and playing bridge and other things that have kept me happy since'.

Jean died in 2003. Robin cared for her at home for the last five years of her life.

In the 1990s, Robin made two additional contributions to the scientific literature. In 1993, in a letter to *New Scientist*, he argued that Bertrand Russell was wrong when he said that 'it is purely a matter of viewpoint whether we think of the Earth going round the Sun or vice versa.' Robin stated that this:

> superficially relativist argument is actually contradicted by the relativistic axiom that no material body can exceed the velocity of light. If the earth were really stationary, the planet Neptune (distance approximately 4,4 billion kilometres) would have to revolve around us at a velocity of 28 billion kilometres a day, or 320 000 kilometres per second, which is greater that the velocity of light (300 000 kilometres per second).[26]

In 1999, Robin wrote to *Chemistry in Britain* asking why a polyethylene tea-caddy that he had bought in Cambridge in 1948 was still as strong and flexible after fifty years of use, whereas all other plastic containers he had bought only lasted a few years![27]

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgements

The authors are grateful to Robin's daughter, Helen, for allowing access to family correspondence and other family information. We thank the archivists at the University of Western Australia and the University of New England for access to their records.

[23] Marsh (2009*b*).
[24] Rard and Palmer (2008).
[25] Rard and Palmer (2008).
[26] Stokes (1993).
[27] Stokes (1999).

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