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Women in Chemistry in Australia: From a Slow Start to a More Promising Future

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In my high school chemistry class it never occurred to me that chemistry might be a male-dominated science because there were no boys in the class! Gender differences were also not that noticeable in my early years at university. They became a little more obvious during honours (4/11), clearly evident during my PhD (1/10 in the laboratory) and more stark as my career progressed. By 1998, as new Associate Professor and acting Head of Department, I attended the Royal Australian Chemistry Institute (RACI) Professor and Heads of Chemistry Departments meeting in Canberra. I can vividly recall arriving late (not unusual for me) and being confronted by rows of mostly grey, some balding and universally male heads. This pattern whereby women enter university science degrees in reasonable numbers and then are 'lost to the system' at every career transition is evident within Australia[1,2] and internationally[3] and occurs across all scientific disciplines, although it is accentuated in the physical sciences and engineering.

For a time, I believed along with many others, that it was just a matter of time before women rose to the top of our profession in reasonable numbers. Yet a key US study[3] shows that the issues facing women in science are not simply a case of the number of scientists in the pipeline. After listening to the stories and commentary at a recent summit on women in science and engineering in Canberra, a senior industry figure remarked that the problem is not a national one but an academic one. It is clear that over and above challenges presented by childrearing, which are generic to all professions and employers, women face covert and overt discrimination and biases intrinsic to academic structures and evaluation criteria.[1,3] Further, it appears these are accentuated when there are fewer women in positions of influence and leadership.

Women have been rare in chemistry[4] and even rarer in the ranks of leadership of academic chemistry[2,5] and in the main professional association, the Royal Australian Chemical Institute (RACI). In 1994, the first and only female national president of RACI, Doreen Clark, was then managing her own highly successful analytical chemistry business. In that case her success relied on her own skills and acumen rather than evaluation by traditions of the discipline.

The conspicuous lack of early role models was not confined to Australia. Prior to 2009 when Ada Yonath was awarded the Nobel Prize for Chemistry, the last women chemist to be awarded a Nobel Prize was Dorothy Hodgson in 1964. Yonath, Hodgson and Marie and Isabel Curie comprise the entire complement of women chemists to be so honoured. This ratio of 4 to 155 male winners is more than double the ratio in physics where there are two winners (Marie Curie in 1903 and Marie Goppert Mayer in 1963), compared with their 186 male colleagues, but less than half the number in physiology and medicine (10 is to 186). As a postdoc at the Australian National University (ANU), I became aware of the work of Rita Cornforth, who published 41 papers with her husband: the 1975 Nobel Laureate in chemistry. In his Nobel lecture, John Cornforth described her work in this way: 'With patience and great experimental skill [she] executed much of the chemical synthesis on which the success of the work was founded.'[6] It is difficult to assess the relative contributions from afar, but I have often wondered if, in a different era, she would have been nominated along with her husband. The ANU established the Rita Cornforth Fellowship in her honour – and Michelle Coote, one of the contributors to this issue, has held that Fellowship. The Cornforth Foundation established at their *alma mater*, the University of Sydney, recognises their combined contributions.

With the exception of Rita Cornforth and Ruby Foon, who taught and did research in kinetics at UNSW when I was a student, I had been mostly unaware of any other early women chemists for much of my career. Recently, I began exploring the

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lives and contributions of women scientists in Australia in the early part of the last century as background research for the new Australian Laureate Fellows for outstanding female applicants. A search of the *Australian Dictionary of Biography* online for the terms 'chemist' and 'female' revealed several remarkable women who were daughters, sisters or wives of chemists. Mary Alice Evatt,[7] wife of Doc Evatt and an artist in her own right, was the daughter of a chemist. So too was Freda Bage: the first principal of Women's College at the University of Queensland.[8] The only practising chemist revealed by this search was Joan Burton Bradley (1916–1982),[9] who was employed as an industrial chemist, but was better known as a naturalist and a pioneer in bush regeneration. Combining all these interests, in 1966 Joan alerted the press to the observation that exposure to small doses of organochlorine pesticides was causing sterility in small birds near her home on the north shore in Sydney.

The *Encyclopeadia of Australian Science* provides a few more examples,[10] including Jean Alexander (1892–1977), a chemistry demonstrator and lecturer at the University of Melbourne. Elaine Browne (1931–1993) and June Griffith (1924–1978) also started as demonstrators and reached the level of senior lecturer at the University of Tasmania and University of New South Wales, respectively. Jean Youatt was employed as a chemistry lecturer at Monash from 1962 to 1990 and established an international reputation for research on the fungi *Allomyces*, and has an impressive publication record. In an interview for the Academy of Science, Jean describes her reasons for not seeking promotion as partly a consequence of working at the interface of chemistry and microbiology and in part because of the lack of encouragement. She recalls:

> I did twice go and see professors about promotion, but I got no encouragement at all and I didn't know then what to do. To this day I don't know what the process is. I didn't know you could go ahead and apply anyway, so I just gave up. But that was part of my upbringing too: I had the reverse of assertiveness training.[11]

There were small numbers outside academia including Moira Dynon (1920–1976),[12] who was responsible for the RAAF chemical warfare munitions and storage throughout Australia during the war, and Jessie Ferguson (1911–1996), who was the Chief Analytical Chemist at Barrett Brothers and Burston, where she had worked from 1937 to 1974. Isabel Bear (1927–) AM, FRACI, had a distinguished career at CSIRO as a mineral chemist, discovering new metastable zirconium sulfate hydrates. She had significant overseas experience, yet she remained on the technical staff until around the age of 40 when she became the first and only woman appointed to the research staff of the Division of Mineral Chemistry in 1967. Isabel worked at CSIRO in a time when women were paid less than men at the same rank and when married women had to resign their permanent positions, thereby losing access to superannuation. Her achievements in that environment are even more remarkable. She was the first (and still only) woman to receive the Leighton Medal, the most prestigious award from RACI.

Other RACI female award winners are also rare. An imperfect search[13] of the list of over 100 RACI senior medal winners list shows Rennie medalists Margaret Harding (1993) and Michelle Coote (2006) have also won the Biota Award (1995) and Le Fevre Prize (2010), respectively. The Biota has also been won by Katrina Jollife (2006) and Rachel Codd (2010). Barbara Messele (2001) and Marie Cifeuntes (2006) have won the Organometallic Award, and Maria Syllas-Kazacos, one of the earliest female professors of chemical engineering, won the Industrial Chemistry Award (2000). An impressive, albeit very short, list.

For women to win prizes they must be working in chemistry in the first place. In 1992, it was estimated that there were just 16 women out of 483 chemistry academics in Australia. By 1995, this number had risen to 30.[4] In the absence of current figures, the numbers of female chemists on Australian Research Council grant proposals provide some indication of the progress of women chemists in academia. During the past 10 years (submit year 2001 to 2010, inclusive), the total number of female chemists on ARC proposals has risen from 70 in 2001 to ~120 in 2010 – an increase of ~70%. This increase is proportionally higher than the overall increase in female researchers on ARC grants applications; from ~2000 in 2001 to 3100 in 2010 – an increase of ~50%. The proportion of female applicants in chemistry proposals is also on the rise, increasing from 12% in 2001 to around 18% in 2010. More importantly, the involvement of female chemists in *successful* ARC grant proposals increased from 11% to nearly 20% in the past 10 years. Female chemists have a slightly lower success rate (38%) than their male counterparts (39%), when all ARC schemes are considered for the past 10 years. The highest number of female applicants is found in physical and structural chemistry and the lowest in inorganic chemistry. It is significant that there has been only one Federation Fellowship, Jill Trewhella, in the area of chemistry compared with 18 male Federation and Australia Laureate Fellows. Self-described as a biophysicist, former ARC Federation Fellow – now Deputy Vice-Chancellor (Research) – Jill Trewhella tells her story elsewhere in this issue. I was also pleased to see a contribution from Jennifer Martin, whose ARC Australian Laureate Fellowship falls outside these statistics into biochemistry.

To help address the small number of successful women in this most prestigious ARC scheme, the Australian Laureate Fellowships, the ARC has added two additional fellowships in 2011. These fellowships, named after Georgina Sweet[14] and Kathleen Fitzpatrick[15] will be awarded each year to the top female applicant in science and technology and in the humanities, arts and social sciences respectively. By naming two fellowships after prominent women researchers we hope to encourage more suitably qualified women to apply, since we know that women are generally (though not exclusively) less inclined to think they are competitive in such awards. Even today some of our most successful women still suffer from the same reticence that stopped Jean Youatt applying for promotion many years ago.

From two female professors in 2000, there are more than a dozen in 2011, and outstanding women chemists are leading high-performing research groups, schools, departments, and faculties and are in the senior executive of several universities. Younger women entering chemistry now have a more numerous and more senior array of possible mentors and role models. There is cause for optimism, as the breadth and quality of the publications in this special issue are further evidence. A message to the entire Australian chemistry community is to think about the depth of this talent when considering your next prize nomination or list of possible invitations to an important conference or meeting. It is a collective responsibility to showcase these role models to the future generation of chemists in Australia, if we want to ensure that we capture all possible talent in our important and enabling discipline.

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