2007 King Faisal International Prize in Science

ACCEPTANCE SPEECH

The roster of scientists who have won the King Faisal Prize for Science is a dauntingly impressive one. If I limit the roll call to only those scientists who have expressed their creativity through the medium of Chemistry, then I come across the names of Zewail and Al-Sayyid, of Cotton and Lemieux, of Noyori, Seebach and Sharpless, and of Hawthorne and Nakanishi. In the past few decades, they shaped Chemistry's history and now they populate its pantheon. What an honor it is to join their company! I extend my thanks most warmly to the Board of the King Faisal International Prize for choosing me in the year 2007 as the sole winner in the category of science. I note that, on only six previous occasions, has the science prize been awarded to an individual. It is indeed a humbling experience for me to find myself joining this elite sextet.

My approach to Chemistry as the central science has been far from a traditional one. Some would say it has been iconoclastic. It has highlighted my passion, working both independently and collaboratively as circumstances have dictated, for making, measuring and modeling, all performed at one and the same time. I am of the opinion that it is essential to make, measure and model all at once in Chemistry, in order to contribute significantly to its intellectual challenge and societal value at this time in history. More than a millennium ago, Jabir Ibn Hayyan was a prominent Arab alchemist and has been referred to as "the father of Chemistry." He is widely credited with the introduction of the experimental method into alchemy, and with the invention of numerous important processes still used in modern chemistry today. "The first essential in chemistry," he said, "is that you should perform practical work and conduct experiments, for he who performs not practical work nor makes experiments

will never attain the least degree of mastery." I couldn't agree more. Making comes first and foremost. It is the acts of designing and synthesizing a product or a material with a particular form and/or function that distinguishes Chemistry from its cognate sciences. It was Marcellin Berthelot (1827–1907) who, in 1860, stated, "La Chimie crée son objet." – "Chemistry creates its object." He continued, "Cette faculté créatrice, semblable à celle de l'art lui-même, la distingue essentiellement des sciences naturelles et historiques." – "This creative capability, resembling that of art itself, distinguishes it essentially from the natural and historical sciences." As one of Berthelot's most fervent disciples these past 35 years, I have been a sculptor of matter at the ultimate of size levels that equates with being a chemist – namely the molecular level. I have faced formidable challenges, yet derived no end of pleasure from designing and synthesizing molecular compounds of a somewhat bizarre kind. These exotic compounds have contained, in addition to the classical chemical bonds, a mechanical bond.

When members of my research group first made molecules called catenanes – a term derived from the Latin word 'catena' for 'chain' – which are composed of two or more interlocked rings, and rotaxanes – a term derived from the Latin words 'rota' for 'wheel' and 'axis' for 'axle' – where a dumbbell-shaped component is encircled by one or more large rings, the compounds were looked upon as cute. "But, are they good for anything?," people asked. Well, since moving from England to California in 1997, we have introduced bistability into both catenanes and rotaxanes and these smallest of machines are now making their way, by dint of collaboration with other scientists, into information processing systems and artificial molecular motors. Essentially, these minute switches and tiny engines have been designed and built with the intent of elevating molecular nanotechnology from being mainly, if not solely

about form, to being largely about function. In the context of nanosystems, form is relatively easy to achieve: it is function that is devilishly more difficult to address. Much latter-day nanotechnology today looks good in cosmetics and paints and stained-glass windows. Contemporary and creative chemistry holds the key to the nanotechnology of the future, that not only looks good, but also works as well to produce widgets. It has taken me the best part of 25 years to get within sight of a molecular computer. Aside from the all-important making part of my Chemistry, it has also involved a lot of measuring and modeling, much of it done collaboratively with other highly talented scientists. During my scientific career, team work has become an increasingly important component of doing cutting-edge research. Another has been a readiness to move between centers of creativity in science. The trail of brilliant young men and women who have followed me through thick and thin from the Athens of the North to the City of Angels with brief and not so brief interludes on the edge of the Canadian Shield, in the Socialist Republic of South Yorkshire, on the Plains of Cheshire beside the Wirral, and in the Midlands in the heartland of Albion have now had their achievements recognised and honored here in the place of Gardens and Trees at the highest of levels on the international scene. I know that every one of them would happily join with me in thanking the King Faisal Foundation most warmly for giving its seal of approval to the quality and significance of the science done by the Stoddart group.

Indeed, a major facet of scientific progress lies in the training of young scientists to carry the torch of discovery and invention in the sciences onwards and upwards into the next generation. Perhaps the most satisfying part of my life's experience as an academic researcher has been as a mentor to close on 300 graduate students and postdoctoral scholars. I have been immensely privileged to have had the opportunity

to carry out my research on a daily basis alongside some of the most brilliant minds and talented pairs of hands in that age bracket between 18 and 28. It is sheer magic. I have had it in mind for some time now to establish prizes for scientific excellence and service to go to young researchers in those universities that have sustained my research activities over the past 40 years. It is these young people who need to be recognised and encouraged to express their creativity at a very early stage in their lives. The King Faisal International Prize in Science gives me the opportunity to accelerate my philanthropic plans. Echoing what is purported to be the last statement of Jabir Ibn Hayyan, "My wealth let sons and brethren part. Some things they cannot share: my work well done, my noble heart – these are mine own to wear."

I have something to add that is rather personal and deeply felt. I lost my wife, Norma, in early 2004 from the ravages of breast cancer. Her struggle with that insidious disease was to occupy 12 years of her life from 1992 to 2004, that is, a fifth of her own life and one-third of our married lives. Herself a Ph D chemist, Norma was the matriarch of the Stoddart group for a quarter of a century, as well as the proud mother of two daughters, Fiona and Alison, who also subsequently graduated with Ph D degrees in Chemistry, Fiona from Imperial College London, and Alison from the University of Durham in the UK. It is with more than a tinge of sadness that we, as a closely knit family, reflect upon the massive contribution Norma made to my and their accomplishments, and yet was not spared to share in them. It is just one of those slings and arrows of outrageous fortune that we have had to bear and accept in the knowledge that she would surely have been an immensely proud spouse and contented mother today if she had lived to see it. The prize stands as a monument to her life and work.